NEW ZEALAND
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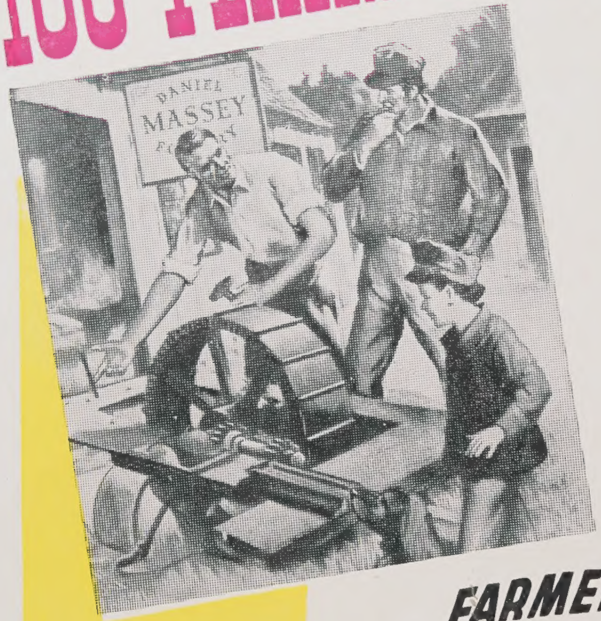

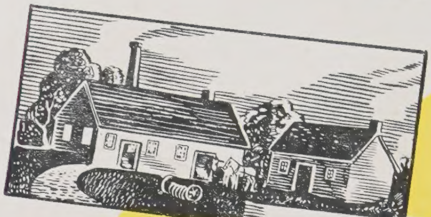
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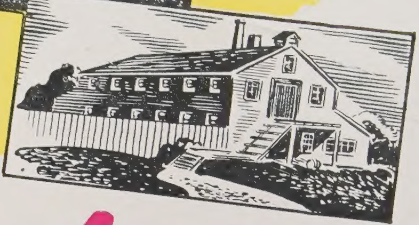
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Minister of Agriculture.

This month's cover

A group of thoroughbred brood mares out at grass on a ridge of Sir James Fletcher's beautiful Alton Lodge Stud at Te Kauwhata, Waikato, has been painted for this month's cover by L. C. Mitchell. Breeding of thoroughbred stock has an important part in the Dominion's primary production, and about 4000 brood mares are used at the stud each year. At the yearling sales in 1947 stock of a value of almost £250,000 was sold, and the value of the yearlings, racehorses, and brood mares sold for export amounted to nearly £100,000.

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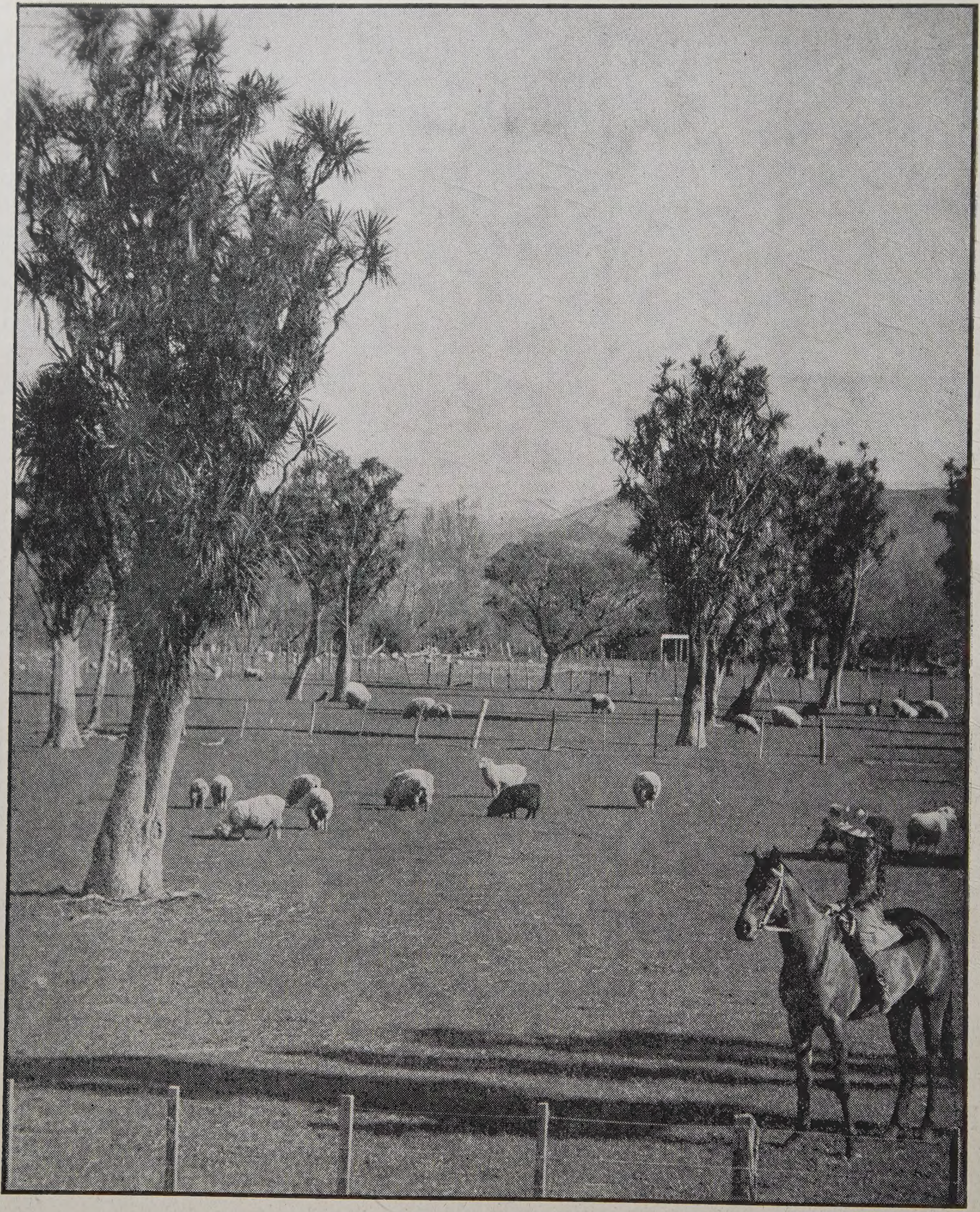

[*National Publicity Studios photo.*

Having rich, fertile soil and an adequate rainfall, Poverty Bay farm lands, of which the above photograph is typical, are well suited to the raising of sheep and cattle.

DEVELOPMENT OF THE DAIRY INDUSTRY

Encouragement of Farm and Factory Efficiency

THOUGH the importance of the dairy industry to New Zealand and its contribution to the food supplies of the United Kingdom, especially during these recent critical years, are generally appreciated, I feel that few fully realise just how important a supplier of dairy products the Dominion has been and how necessary it is that the industry should expand on efficient lines.

The few figures which follow will bring home to every dairy farmer the importance of his contribution to the butter ration of the United Kingdom.

Imports of butter from New Zealand as a percentage of total imports into the United Kingdom.

Year	%	Year	%
1938	27	1944	68
1941	59	1945	62
1942	69	1946	48
1943	66		

Whereas in 1938 the Dominion sent only a little over a quarter of the total butter imported into the United Kingdom, slightly over two-thirds was sent from New Zealand during the latter war years, and nearly half in 1946. It was New Zealand butter which provided the main portion of the British butter ration during the critical war years. The position is slightly different for cheese, because during the war and post-war years the United States of America became an important supplier of cheese, and total imports from all sources have risen considerably as cheese has been used to supplement the meagre meat ration. Though the quantity of cheese exported from New Zealand was increased considerably above the pre-war average during 1941 and 1942 at the request of the United Kingdom, this country's exports have now returned to normal figures, so that though the Dominion sent 56 per cent. of the total imports of cheese in 1938, the percentage had fallen to 40 per cent. in 1946 because of the higher total imports into the United Kingdom.

These figures require little further comment, for they show every dairy farmer the importance of his contribution to the butter and cheese supplies of Great Britain. There is, however, the business aspect of our export trade and the need to secure an expanding market, because dairy farming is the best means of promoting closer settlement in New Zealand. The Government has settled nearly 4000 ex-servicemen on the land, the majority on dairy farms, which will help materially in this direction, and in a few years I anticipate the dairy herds of the Dominion should again reach the highest previous total of 1,800,000 cows.

In the development of dairying the Dairy Industry Commission will provide the farmer with the security of an economic price for his products and thus continue the procedure of orderly buying and selling which was inaugurated under the guaranteed price system. I know that the great majority of dairy farmers have appreciated the benefits of this system. One has only to look back and compare the condition of the industry today with that following the bursting of the boom at the end of the First World War to realise how great those benefits have been.

Developing the efficiency of the dairy industry also requires the progressive development of more highly-productive pastures, adequate supplementary feeding, improved strains of livestock, and the full use of labour-saving machinery. The Dairy Board, the Department of Agriculture, and the Dairy Research Institute are all working to provide the knowledge necessary to improve farm and factory efficiency. It is for the individual farmer armed with the knowledge of economic security to put the proved results of research into practice.

There are certain practices involved in this development which require the immediate attention of all dairy farmers. I have already in the pages of this "Journal" stressed the need for improvement in the feeding of dairy cows, the importance of using the increased fertiliser ration to the best advantage, and the need to increase the supplies of hay, silage, and fodder crops for supplementary feeding. With attention given to these details, production from existing herds should expand, but expansion of production through increased numbers should also receive close attention. The efficiency of an expanding dairy industry is largely dependent on the quality of the surplus calves saved by dairy farmers and their subsequent feeding. Farmers with quality herds have an obligation to the industry to rear as many heifer calves as possible and to feed them well. Recent work at the Ruakura Animal Research Station has shown how the grazing management of calves affects their growth and their resistance to parasites in the winter. Calves should be given the best grazing on the farm and should be rotationally grazed ahead of the dairy herd. Attention to calf rearing and feeding will ensure quality stock for the necessary expansion of the industry.

The Government appreciates the industry's background of high achievement, and I feel the future holds promise of greater things. Let all who are interested see that progress is as efficient as possible. As Minister of Agriculture I intend to develop the research and instructional services of my Department to meet the needs of the industry, and in this work I feel that I will have the full co-operation of the dairy farmers of New Zealand.

EDWARD CULLEN, Minister of Agriculture.

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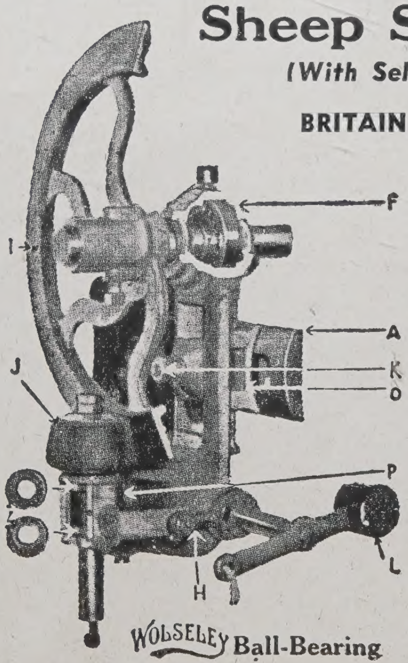

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Results of Trials with Hormone Weedkillers

By P. B. LYNCH, *Crop Experimentalist, Fields Division, Wellington.*

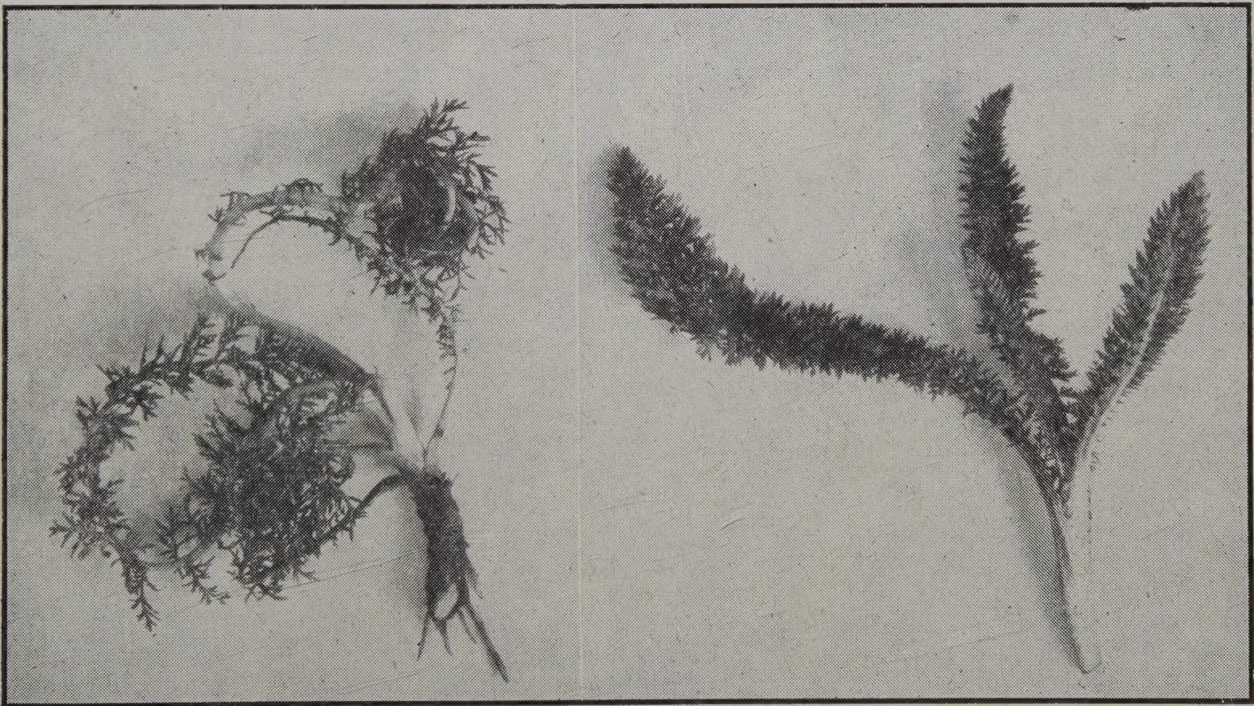
ONE of the recent advances in agricultural science that has aroused interest throughout the farming world has been the development of chemical weedkillers. The most outstanding of these chemicals have been those of a hormone nature, but there have also been advances in other types of weedkillers that can, perhaps, be described more specifically as plant poisons. The Department of Agriculture has been aware of the possible importance of these findings to farming in New Zealand, and the Fields Division has organised an extensive experimental programme to test the materials. This article will deal with those field experiments, but it must be emphasised that the trials are as yet in the initial stages in a great many cases, and the amount of work yet to be undertaken greatly exceeds that accomplished.

IT may be considered that a great deal of overseas work is being duplicated in this country, but time and again such duplication has been found essential if the work done overseas is to be interpreted correctly to the New Zealand farmer. Conditions of farming in New Zealand are very different, for example, from those in the mid-western States of the United States of America; the types of weeds common are not the same, and the types of problems are usually quite different. Farming in England is more allied to that in this Dominion, but when specific cases are considered quite a different emphasis is found to be placed on weed and allied problems. In one country the weed may be present on cropping land and because of that may be easily eradicated in the susceptible seedling stage; in another country it may be a pasture weed and prove resistant because it is treated with weedkiller when fully grown. Even within New Zealand weeds vary greatly in their aggressiveness in different districts and on different soils, and prove difficult or easy to eradicate because of that factor. All the work has shown over and over again that trials must be conducted under the conditions experienced locally before definite recommendations can be made.

Those results should provide a warning against applying the findings of overseas workers without test to the many different local conditions in New Zealand. Still more has the farmer to be on his guard against the sensational type of statement sometimes found in non-authoritative publications, particularly if those statements are based on overseas sources of information. Up to the present, experimental work in New Zealand has pointed to certain distinct possibilities in the use of these new weedkillers, but it does not indicate that the weed problem as it exists in New Zealand today has been solved and that the time-honoured practices of clean farming methods can be superseded by weed control by chemical means.

Poisons and Hormones

Weedkillers may be considered in two classes—plant poisons and hormone-type weedkillers.



A normal yarrow plant (right) compared with one treated with hormone weedkiller, showing characteristic curling of stems and leaves and thickening of the stem base.

PLANT POISONS AND HORMONES . . .

The chemicals commonly regarded as plant poisons include the arsenicals, sodium chlorate and related compounds, sulphuric acid, and when used in excess, materials such as salt, borax, sulphate of ammonia, and sulphate of iron. There is also a large class of compounds derived from oils and tars. These substances do not occur naturally within the plant as do some types of hormones, but are destructive of plant life, and often of animal life also.

In contrast, the plant hormone type of weedkiller is non-poisonous to animal life, except, possibly, in great excess. Many of the plant poisons are corrosive to metals—for example, sulphuric acid—and others, such as sodium chlorate, are unstable compounds likely to promote explosive combustion in the presence of organic materials.

If for no other reason, the safety to animal life which attends the use of the hormone-type weedkillers is a very considerable advantage. The dangers when using sodium chlorate and sulphuric acid have been stressed repeatedly in earlier issues of the "Journal of Agriculture." Nevertheless, the class of compounds termed the D.N.O.C. group, or di-nitro-ortho-cresylates, which has been developed recently, deserves special mention, as does the use of power kerosene for special purposes, notably the eradication of weeds in carrot crops.

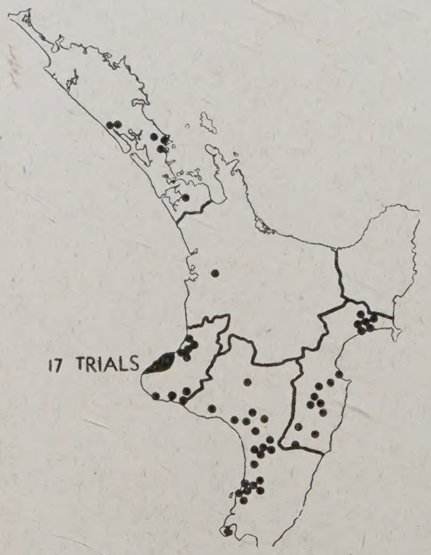
D.N.O.C. compounds, represented by products such as "Sinox" and "Denoc," are poisonous but otherwise safe to handle. Their use on crops such as onions and peas (which, like carrots, are susceptible to hormone weedkillers) was described in the "Journal" for August, 1946, but they will be referred to later in the summary of experiments. Many of these experiments also included the use of sodium chlorate as a standard treatment.

Though in a sense the hormone-type weedkillers can also be classed as plant poisons, their effect on plant growth is usually distinctly different from that of the plant poisons enumerated. They affect plants similarly in some respects to the naturally-occurring plant hormones, and thus these materials have been loosely classified as "hormone" or "hormone-type" weedkillers.

J. P. Hudson, in the "Journal" for August and September, 1946, gave an interesting account of plant hormones, showing how those materials, which occur in the normal growing plant, are essential to their vital activity. Certain substances, for example, are growth hormones and help to explain the reaction of plants to light. The fascinating study of naturally-occurring plant hormones is still in the initial stages, but this article is concerned with the effect of the application to plants of artificially-prepared hormones. These substances are related to the natural plant hormones and cause a similar reaction in the plant. Hudson has listed five uses of these artificially-prepared materials—rooting hormones, transplanting hormones, fruit-set hormones, fruit-drop hormones, and weedkilling hormones. The experiments described are concerned with the last group.

Effects of Hormones

The application of hormone weedkillers as dusts or sprays to susceptible plants produces distinctive reactions which may result in the death of such plants. That effect is caused by the disturbances produced in the normal growth processes as a result of absorption of the hormone. Usually it is not apparent immediately but may extend over several weeks or months.



Location of North Island trials.

The types of distortion that may occur are shown in the illustrations. Commonly they are: Twisting and bending of stems and leaves; thick tissues developing on the stems; watery buds appearing but not developing; stems growing into loops and coils; stems and leaves cracking and dying; cracks, splits, and callouses appearing on stems; leaves changing colour from green to yellow to red; and root systems enlarging and rotting away.

Selective Action

Some plants are resistant to the types of hormones at present developed and some are susceptible; others are resistant at certain stages of growth or under certain conditions, but may be susceptible at other stages or under other conditions. Such selective action is somewhat of a mixed blessing. The fact that nearly all grasses are resistant is of great advantage for obtaining a weed-free lawn but not so advantageous for the eradication of twitch from a paddock.

Nevertheless, there is hope at least that in time specific chemicals will be available for the eradication of specific weeds, including the grass family. Part of the resistance of grasses is caused by their habit of growth; their spear-like leaves, often with a waxy surface, will shed most spray and dust, while broad, flat-leaved plants are commonly susceptible—but that is not the only cause of resistance or susceptibility.

Types of Hormone Weedkillers

The two types of hormone weedkillers in most common use are the 2-4D type (2-4, dichloro-phenoxy-acetic acid), typically developed in the United States and represented by "Weedone," "Dee-Cee-Pee," and many other trade products; and the M.C.P. type (4 chloro 2 methyl-phenoxy-acetic acid), which was developed in England and is the active principle of products such as "Agroxone." In the trials summarised these two types are represented by "Weedone" and "Agroxone," both as sprays and dusts, but the more critical work at the Soil Fertility Research Station includes many other products as well as preparations of the pure chemicals concerned.

The fact that proprietary compounds were used in the trials should not be taken to indicate that these compounds are or are not recommended in comparison with others containing the same active ingredient. The firms concerned made available considerable quantities of these products, and without their co-operation and help it would have been impossible to arrange the extensive experimental programme. "Weedone" was therefore used as representative of the 2-4D class of compounds, and "Agroxone" as representative of the M.C.P. compounds, and it may be inferred reasonably that within such classes of compounds other preparations would have given similar results if they were applied at equivalent amounts of active principle to the acre.

Resistance and Susceptibility

General conditions of resistance and susceptibility are:—

1. Young plants, particularly seedlings, are more susceptible than older plants. In general, the most susceptible stage is that of most vigorous growth. That indicates the importance of treating weeds in crops when they are small or, in the seedling stage.
2. Grasses, cereals, and fine-leaved plants are often (but by no means

invariably) more resistant than broad-leaved plants, particularly if the leaves of the latter lie flat where they can hold the most spray or dust.

3. Woody plants with a low ratio of leaf area to total weight tend to be resistant. Frequently the leaves of such plants are killed by the hormone but fresh leaves soon appear from the little-affected stem.
4. Plants with extensive or fleshy root systems are often resistant, but there are many exceptions, the most notable being the plantains (flat weeds), such as catsear and dandelion, and bindweed or convolvulus. Many plants with extensive root systems require repeated sprayings before the weedkiller is transported to and kills all parts of the plant.
5. Perennial weeds are usually more resistant than annual weeds. This is related to 4 and the same exceptions and conditions apply.

Experiments to Date

In the 18 months up to May 14, 1947, some 120 co-operative experiments were conducted by officers of the Fields Division, and the maps on this page and that opposite show the districts covered by the project. This does not include the large number of trials and critical work conducted at the Soil Fertility Research Station, Hamilton. An article on weedkiller research at Hamilton appeared in the "Journal" for July, 1946, and the work will be summarised in a later issue.

The co-operative experiments have been classified as follows, several trials including treatments of more than one species:—

	Number of trials
Weeds of newly-sown pastures	2
Weeds of established pastures	50
Weeds of waste places and reverted country	50
Weeds of drains and ditches	3
Weeds of poorly-drained pastures	6
Weeds of annual crops ..	32
Total	143

Dilutions of Sprays and Dusts

In the experiments summarised rates of application of sprays are given in gallons of material as supplied by the manufacturers. "Weedone" liquid contains 9.6 per cent. of 2-4D, and "Agroxone" 10 per cent. of M.C.P. The amount of water with which these quantities are used appears to be largely immaterial; dilutions of the order of 1:60 to 1:100 are common, and 100 gallons an acre is a convenient quantity of spray to apply to short growth, larger amounts being required for bushy plants. To apply 1 gallon of "Weedone" an acre it could be diluted 1:100 with water; for 2 gallons an acre 1:50 dilution would be suitable.

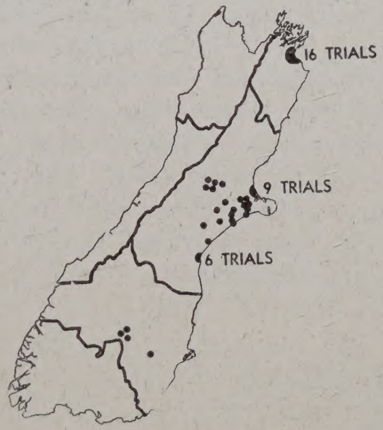
The "Agroxone" dust as used in the trials was in two strengths, 5 per cent. and 1 per cent. The latter was made by mixing the 5 per cent. dust with finely-ground limestone.

Newly-sown Pastures

Two trials were specifically designed to investigate the control of weeds in newly-sown pastures.

One at Blenheim, using "Denoc" (a D.N.O.C. compound), showed a single application of this material to be ineffective against sorrel (*Rumex acetosa*), spurrey or yarr (*Spergula arvensis*), and Curnow's curse (*Calandrinia caulescens*) when applied at the rate of 1 gallon of "Denoc" an acre diluted to 1:100 with water. The pasture was not affected.

At the Marton Experimental Area an acre was sown in the spring with a very light seeding (5lb. of perennial ryegrass and 1lb. of white clover an acre) on a hastily-prepared seed-bed in a deliberate and successful attempt to secure a weed-infested pasture. Strips across this area were treated with various types of weedkillers as sprays and dusts. The most prominent weeds were scarlet pimpernel (*Anagallis arvensis*), spurrey, redshank (*Polygonum persicaria*), narrow- and broad-leaved docks (*Rumex crispus* and *Rumex obtusifolius*), black nightshade (*Solanum nigrum*), sorrel, fat-hen (*Chenopodium album*), sowthistle (*Sonchus oleraceous*), Scotch thistle (*Cirsium lanceolatum*), hawkbit (*Leontodon hispidus*), dandelion (*Taraxacum officinale*), and narrow-leaved plantain (*Plantago lanceolata*).



Location of South Island trials.

The treatments were applied on December 3, 1946. After about two months the plots sprayed with "Weedone" at 2 gallons an acre were comparatively free of weeds, while the grasses and clovers were growing vigorously. The "Agroxone" plots were only slightly less successful, but the spray treatments generally were much superior to the dusts.

"Denoc" proved too severe on the grasses and clovers, which is of interest in view of the results obtained at Blenheim. But in that trial the pasture was much further advanced; at Marton the pasture species were in the seedling stage, when they are much more susceptible to weedkillers.

The next stage with this trial was to apply the most successful treatment ("Weedone") in a block across all plots. That was done in March of this year, and subsequently sections of that block were surface sown and topdressed in an endeavour to obtain a good sward from a very poor and weedy initial establishment. By May it appeared that this object would be achieved. Even where not surface sown or topdressed, the treated block was looking very well, with the grass and clover free of weeds and thickening up remarkably well.

Though this trial promises to be highly successful, some warnings are necessary:—

1. Clover species under certain conditions, particularly as seedlings, have proved to be susceptible to hormone sprays, and there is a danger of affecting swards seriously by indiscriminate use of such materials.

2. This procedure should not be required if the ground has been properly prepared for sowing, and such preparation would be much cheaper than reliance on weedkillers.

3. In general, the weeds were treated in the stage when they are susceptible. If they were well established in pasture, their eradication might be more difficult.

4. Many of the weed species eradicated are annual weeds which in any case would have disappeared eventually after the area had been grazed for a period.

Established Pasture

Trials with weeds in established pasture have been grouped under the major weeds treated:—

Ragwort (*Senecio Jacobaea*)

Ten trials with ragwort were established—at New Plymouth, Whakamara (Hawera), Kai Iwi (Wanganui), Patea, Wairoa, Marumaru (Wairoa—three trials), Opaku (Patea), and Pahiatua track—but only those at New Plymouth, Whakamara, Opaku, and the Pahiatua track are sufficiently advanced to indicate final results. All trials except the Pahiatua track one included sodium chlorate as the standard treatment, because it is the weedkiller from which the greatest success has been secured in the past.

Farmers

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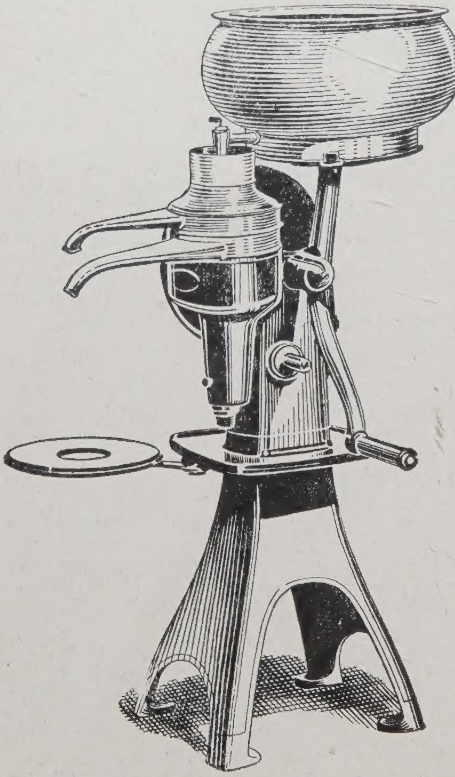

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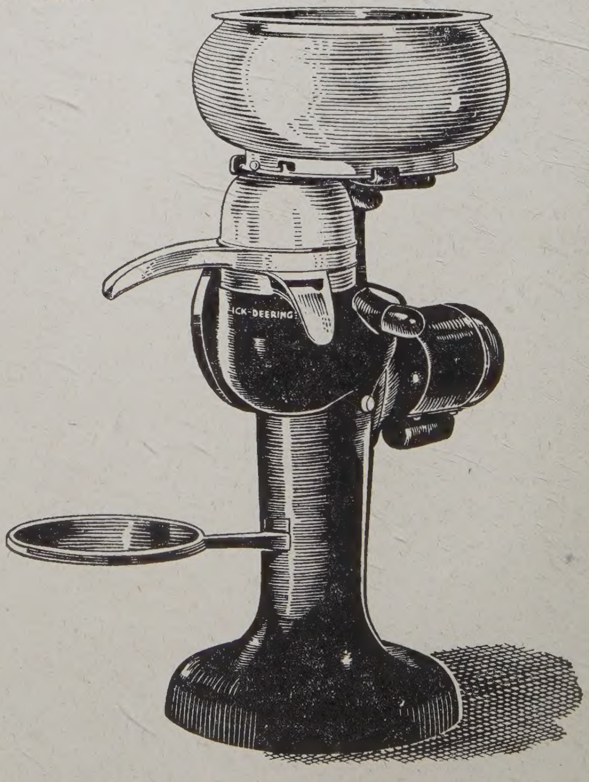


To date results from the hormone weedkillers have been rather disappointing, but there is evidence that, at least in part, that is caused by lack of knowledge of such factors as the best times of application and quantities to apply. It was hoped that the hormone weedkillers, by penetrating further into the root system of the plant, would ensure complete kills. The main disadvantage with sodium chlorate treatments is the likelihood of regrowths from unaffected roots, after the tops have been killed. Nevertheless, at the Soil Fertility Research Station, Hamilton, considerable success has been achieved with the new weedkillers, and in all field trials described at least a proportion of the ragwort plants have apparently been killed by such means. It is too early to say whether regrowths will appear, but the following points have been illustrated by the trials:—

1. Hormones must be applied before the plants approach maturity. Because of the time taken for the hormones to act, ragwort will set seed if application is delayed too long. That is in direct contrast to the rapid effect of sodium chlorate.
2. Sprays are considerably more efficient than dusts when applied at equivalent rates of active ingredient.
3. Probably at least 2 gallons an acre of concentrate (which in "Weedone" is 9.6 per cent. 2-4D and in "Agroxone" is 10 per cent. M.C.P.), or at least 5cwt. of a 1 per cent. (of 2-4D or M.C.P.) dust or 1cwt. of a 5 per cent. dust, is required. That is, relatively heavy applications should be used.
4. "Weedone" spray tends to be more effective than "Agroxone" spray at equivalent rates.
5. Heavy rain shortly after spraying or dusting may reduce the effectiveness of the treatments considerably.

Hard fern (*Paesia scaberula*)

Three trials with hard fern have been laid down at Mt. Messenger, Otaki, and Levin.

In all cases the hormones have done little more than burn and twist the leaf margins and tips of the fern, and must be considered unsatisfactory.

It is interesting to note, however, that a dust of sodium chlorate and lime (5 per cent.), applied at 5cwt. and 10cwt. an acre in these experiments, killed and dried out fern patches so that they would burn out thoroughly and could be resown effectively. However, the cost of such treatment would be high, and on hill country, where hard fern is a problem, application is difficult and costly.

It is possible that hormone sprays would have been more effective than the dusts which were used in the trials, but the carriage of the water required would make such treatment impracticable for the farmer.

Twin Cress (*Coronopus didymus*)

Two trials, one at Opotiki and one at Turakina, were laid down in an endeavour to eradicate twin cress from pasture which had been seriously tainting the cream of cows.

It would appear from these trials that twin cress is susceptible to the hormone weedkillers, but that it may be difficult, particularly if the pasture growth is long, to obtain the complete eradication which is probably necessary to eliminate cress taint in cream. Such complete eradication is rarely secured with a single application of treatments because of the difficulty of treating every plant with spray or dust.

Heavy applications do not appear to be necessary: 1 gallon of spray or 2cwt. of 1 per cent. dust an acre would appear to be sufficient. Considerable damage to the sward, and especially to clovers, occurred with heavier applications. Again "Weedone" was more effective than "Agroxone," but the latter would seem to give quite efficient control of the cress without the danger of affecting the pasture seriously.

Sodium chlorate-lime dusts (5 per cent.) at 5cwt. an acre effectively eradicated cress on the Turakina trial but damaged the sward severely.

Tutsan (*Hypericum androsaemum*)

Three trials, at Ngaio, Uruti, and Te Pahu (Raglan), have all demonstrated the inability of the hormone weedkillers at standard rates of application to do little more than discolour tutsan. Sprays and dusts are equally ineffective.

Californian thistle (*Cirsium arvense*)

Ten trials on Californian thistle in pasture were laid down at Tataraimaka (North Taranaki), Puniho (North Taranaki), Tiakitahuna (Palmerston North), Ohau, Ohakune, Redcliffs (Christchurch), Tuamarina (Blenheim), and Temuka (three trials).

Insufficient reports are available from the trials at Tiakitahuna and Puniho, but seven of the remaining eight trials give considerable promise that Californian thistle may be eradicated by the use of hormone weedkillers.

The exception was the Tuamarina trial, in which recovery occurred after treatment with "Weedone." Before definite "kills" can be established it will be necessary to wait until next spring to see if regrowths occur. Nevertheless an officer of the Fields Division, Christchurch, reported that the Californian thistle in the Redcliffs trials was "hollowed out in the stem and the roots were dry and stringy," and the plants are presumed killed. A similar effect was reported from Timaru after a treatment of 2cwt. of 5 per cent. "Agroxone" dust. Similar promising results were secured at Hamilton and by the Agronomy Division, Lincoln.

It would seem that there is a considerable penetration of the root system by the hormone weedkillers when applications are made to the stems and leaves of the order of 2 to 4cwt. of 5 per cent. dust or 1 to 2 gallons of spray (about 10 per cent.) an acre. "Weedone" spray appears to be the most effective treatment, but good results were also secured with "Agroxone" dusts. "Sinox" and "Denoc" sprays were comparatively ineffective. Applications appear most likely to give complete kills when the plants have the maximum leaf growth, shortly before flowering, but to delay spraying until flowering is unwise because then the plant frequently can set seed before dying off.

Repeat applications would probably be necessary in most cases to eradicate a patch of Californian thistle completely, but the results to date have been sufficiently encouraging to warrant an intensive investigation into the best time of the year, method of application, amount and type of weedkiller, stage of growth of the weed, and other factors connected with the effectiveness of the materials, which will enable more definite recommendations to be given later.

Scotch thistle (*Cirsium lanceolatum*)

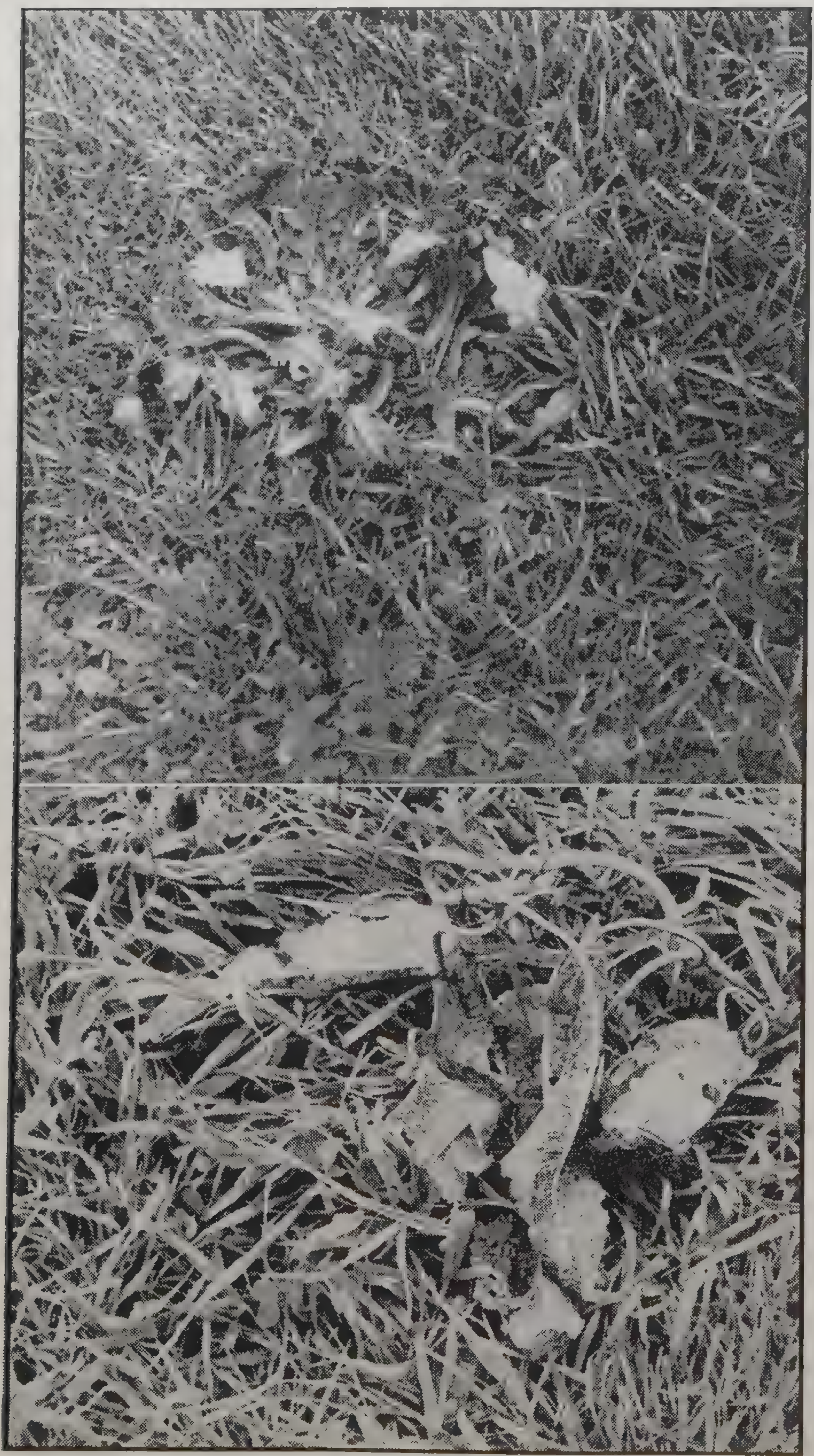
Trials at Warkworth, New Plymouth, and Redcliffs, as well as many experiments in which this weed was treated with other species, show that the hormone weedkillers will readily eradicate Scotch thistle. Comparatively-light applications (1 gallon of 10 per cent. spray or 2 to 3cwt. of 1 per cent. dust an acre) are sufficient, heavier dressings merely hastening the kill.

Variegated thistle (*Silybum marianum*)

Trials on variegated thistle are located at Poukawa in Hawke's Bay (two trials), Makirikiri (Wanganui), and Redcliffs. In the first three sodium chlorate was included as standard treatment.

Eradication of the weed was secured at Makirikiri with 5cwt. and 10cwt. an acre of 1 per cent. "Agroxone" dust, and at Redcliffs with sprays of both "Weedone" and "Agroxone." Huge thistles, covering more than three-quarters of the ground surface, were eradicated at Makirikiri, where sodium chlorate, though it killed the top growth, did not prevent regrowths.

The results in Hawke's Bay were not so promising. Though there was a considerable mortality in plants treated with "Agroxone" dust, 3cwt.



Upper—Catsear, a familiar weed of pasture, showing typical reaction to hormone weedkillers. When this stage is reached the plant usually dies in a few weeks. Lower—A dock plant with stems growing into loops and coils after being sprayed with hormone weedkiller.

and 5cwt. an acre of a 5 per cent. sodium chlorate-lime dust gave complete eradication. However, the trial was not completed, for stock grazed the area and ate the wilted thistle leaves on all treated plots. In the second trial at Poukawa sprays of hormone weedkillers proved superior to the dusts.

Further work is needed on this weed, but there is every prospect that under certain conditions, yet to be established, the troublesome variegated thistle can be eradicated with hormone weedkillers.

Winged and nodding thistles (*Carduus tenuiflorus and Carduus nutans*)

Winged and nodding thistles appear to be similar to Scotch thistle in their reaction to hormone weedkillers. Such treatments should prove an effective means of eradication, especially if the materials are applied as sprays.

Flat weeds of pastures

The following species of flat weeds were included in eight trials: Pennyroyal (*Mentha pulegium*), dandelion (*Taraxacum officinale*), curled dock (*Rumex crispus*), catsear (*Hypochaeris radicata*), broad-leaved dock (*Rumex obtusifolius*), ribgrass (*Plantago lanceolata*), fiddle dock (*Rumex pulcher*), self-heal (*Prunella vulgaris*), cape weed (*Cryptostemma calendulacea*), lamb's tongue or broad-leaved plantain (*Plantago major*), daisy (*Bellis perennis*), mouse-eared chickweed (*Cerastium glomeratum*), hawkbit (*Leonotodon hispidus*), cut-leaved geranium (*Geranium dissectum*), moss and soft geranium (*Geranium molle*).

Practically all those species proved susceptible to the hormone weedkillers. The exceptions are mouse-eared chickweed and moss, which appear to be resistant, and the geraniums, which are somewhat more resistant than the other species. The fact that these include most of the common lawn weeds shows how valuable the hormone weedkillers are for cleaning lawns of weeds.

Both dusts and sprays are effective with relatively-light applications—2 to 3cwt. of 1 per cent. dust and 1 to 2 gallons of 10 per cent. spray an acre. "Weedone" spray is the most drastic treatment, but tends to be more severe on clovers than the other materials and also checks the grass growth to a greater extent. Equal effectiveness is possible with smaller applications of "Weedone" than of the other materials. The superiority of sprays over dusts tends to be less marked on flat weeds, probably because such weeds hold the dust well.

Though the treatments can be safely recommended for lawns, farmers will do well to consider the cost of obtaining the benefits of a pasture free of flat weeds. If the cause of the pasture becoming weedy is not removed—

causes such as overstocking, poaching, poor draining, and lack of topdressing —the beneficial effect of treatment with weedkiller will be only temporary. In a number of cases adequate fertilising will eventually produce the same result as the application of weedkiller and at the same time give a more productive pasture. That procedure would be much more economic than one which treats effects and not causes.

Bidibidi (*Acaena sanguisorbae*)

In two trials conducted so far bidibidi was resistant to sprays and dusts of hormone weedkillers applied at rates up to 2 gallons of 10 per cent. spray an acre.

Redshank (*Polygonum persicaria*)

In two trials redshank has shown that it is not particularly susceptible and probably requires spray applications of the order of 2 gallons an acre for control. However, much more work must be carried out with this species.

Waxweed (*Hydrocotyle Americana*)

In one trial at New Plymouth the indications are that waxweed will be controlled with the usual rates of application of the hormone weedkillers. Hairy pennywort (*Hydrocotyle moschata*) was also killed in this trial.

Waste Places and Reverted Country

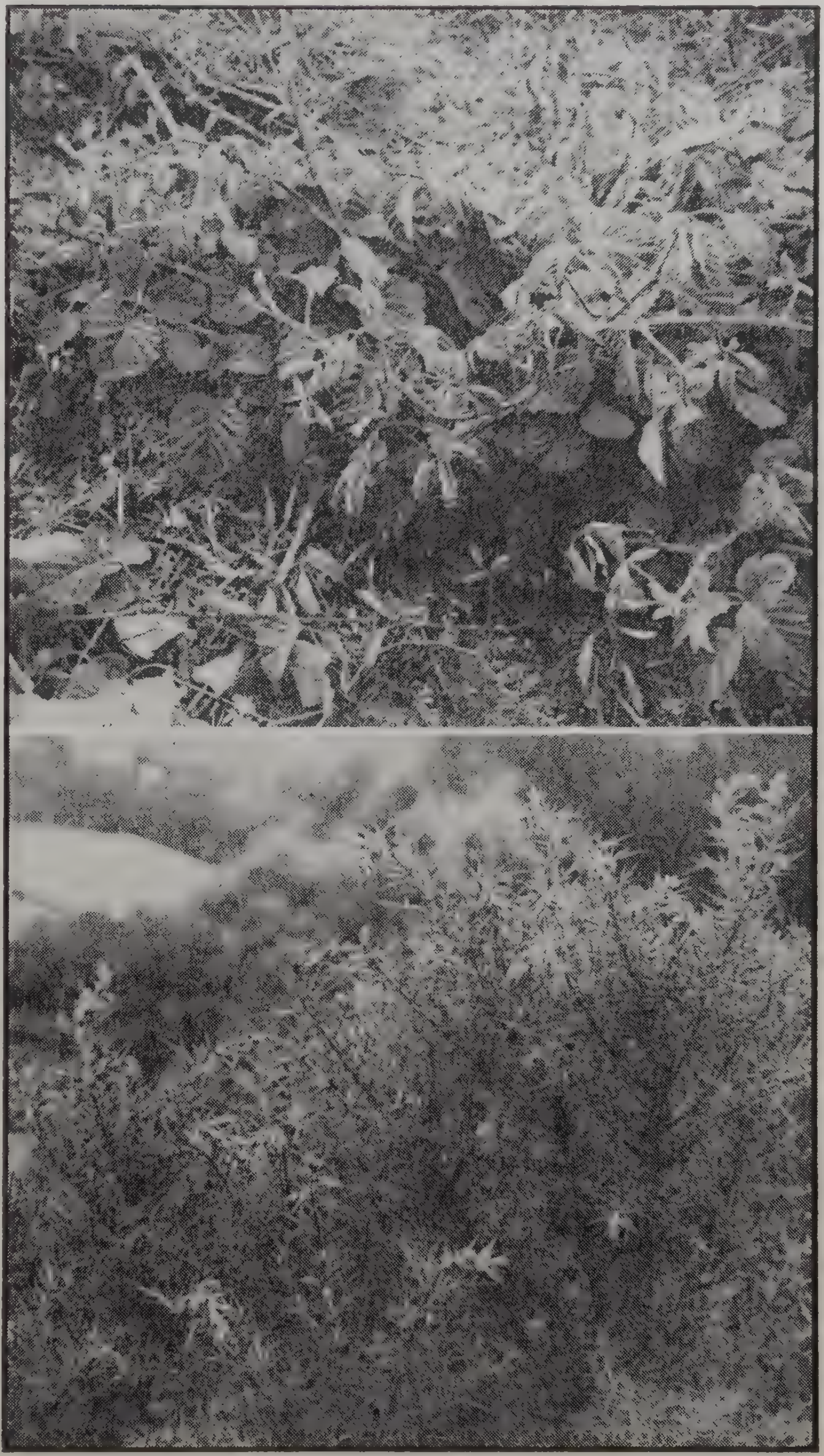
Some of the weeds of waste places and reverted country listed are troublesome in pastures in some districts, but in general they are not difficult to eradicate on ploughable land. As the weeds in most cases are a serious problem on land of relatively-low value, the high cost of their eradication (where possible) by chemical means and the difficulty of applying such chemicals make the economic value of the results on a large scale doubtful. Nevertheless, the cleaning up of small patches of the weeds in inaccessible places, or the removal of a potential menace to better-class land, may make a relatively-expensive weed-killing programme well worth while.

Blackberry (*Rubus fruticosus* and other *Rubus* species)

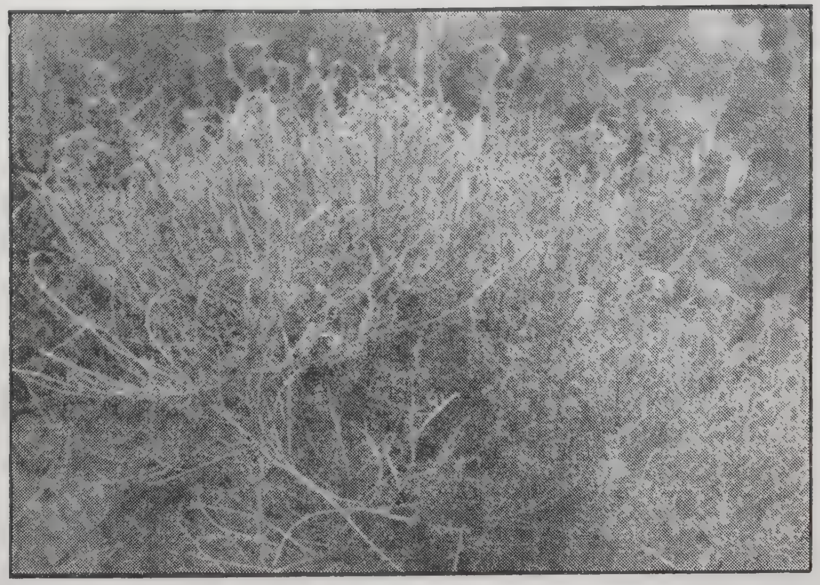
Blackberry has become one of the most serious weeds in the North Island. Large-scale infestations can probably be held in check only by goats, but the use of chemical weedkillers to clean up small areas or drains choked with blackberry may be warranted in many circumstances.

Twelve trials are being conducted on blackberry—at Tataraimaka (North Taranaki—two trials), New Plymouth, Egmont Village, Ngaio, Waitara, Westport, Temuka (two trials), Spring Creek (Marlborough), Doyleston, and Wairoa. Insufficient reports are available from the Waitara, one of the Temuka, and the Egmont Village trials.

BLACKBERRY AND GORSE



Upper—Blackberry which has regrown after being cut. It has been treated with a "Weedone" type of spray at a high concentration, but little damage has resulted beyond curling of the shoots and some of the leaves. Lower—An adult gorse bush after treatment with a "Weedone" type of spray. The ends of the stems have curled, but the plant has not been seriously damaged.



Part of an adult broom plant shortly after treatment with "Weedone" spray. The effects are spectacular, including curling and elongation of stems and loss of leaves.

The remaining nine trials give very little hope that any of the hormone-type weedkillers applied as such will eradicate blackberry. An initial reaction is shown in the curling of the leaves and the tips of the shoots. "Weedone" spray, which appears to be the most effective, causes the leaves to blacken and drop off. Flowering and fruit setting may be affected if spraying is done at that time, but in a short while the plants have fully recovered from the effect of the treatment and are no different from those in the "no treatment" plots.

Nevertheless, there are some hopeful signs. The Fields Division, Christchurch, reports as follows concerning the Doyleston trial: "Blackberry treated with 'Weedone' and water was affected at first but later recovered, the growth becoming more prolific than ever and the foliage turning a darker and more healthy green than that of the untreated blackberry. When 'Weedone' was mixed with power kerosene instead of water, however, the effect was startling. Within 10 days the young blackberry was black and brittle above the ground level. The old blackberry first lost its foliage, then the stems turned black and finally white, being very brittle over the whole length. This year's wood has definitely been killed, but whether the treatment will stop the blackberry from coming up again next year is doubtful."

Here is a promising line of attack which will be followed with many additional experiments. The proportions used were 1:30 and 1:60 "Weedone" and kerosene.

Overseas work seems to suggest that the use of a spray of 1lb. of ammonium nitrate to 5 gallons of water, applied to the plants before spraying with a hormone weedkiller, gives more effective results than the weedkiller applied alone. That will also be investigated in New Zealand.

Gorse (*Ulex Europaeus*)

Five trials out of 11 with gorse have sufficient data for the purposes of this summary. These trials are at Ngaio, Wairoa, Cass, Haumoana, and Doyleston.

The reaction of gorse to hormone weedkillers is somewhat similar to that of blackberry, though with heavier applications of "Weedone" spray (2 to 4 gallons an acre) there is mortality of seedlings and regrowth from cut stumps. "Weedone" is much more effective than "Agroxone." Dust applications seem quite ineffective. Lighter applications of sprays, or spraying of mature woody plants, cause some wilting and curling of shoots—as with blackberry—but in general the plant recovers completely after several weeks. Relatively-heavy applications of spray to practically bare ground left after the cutting and removal of tall gorse at Ngaio did not prevent a prolific germination of gorse seedlings four to five weeks after spraying.

Occasionally young gorse is killed by "Weedone" sprayed at lighter dilutions, but old gorse is much more resistant. However, there has been some measure of success with the "Weedone"-kerosene mixture used on blackberry at Christchurch, where it is reported: "Old gorse treated with 'Weedone' and kerosene turned a light yellowish-brown over the whole of the foliage, including the major stems, which have all become very dry and have shown no signs of recovery."

This promising result will be followed up with further work, though the limited practicability of such treatment by farmers may well make its economic application out of the question.

Sweet Brier (*Rosa eglanteria*)

Four trials have been conducted with sweet brier, two at Cass and one each at Redcliffs and Alexandra.

Spraying with "Weedone" appears to do little more than check the growth of sweet brier, but at Redcliffs "Agroxone" spray (1:60 dilution) applied in sufficient quantity to wet the foliage thoroughly caused the leaves to wilt and later become brittle, the hips to turn brownish and dry out, and the stems to be killed for a considerable distance, though they remained green at the base. A repeat spraying may result in complete kills.

Broom (*Cytisus monspessulanus*)

Trials at Cass and Ngaio showed that "Weedone" spray, particularly in high concentrations, has a spectacular effect on broom, the leaves wilting and blackening in a few hours. It is impossible at present to be certain of kills in mature plants, but the indications are that the treatment will be successful.

"Agroxone" spray is less efficient than "Weedone" on broom, and dusts seem to be of little value, probably because of the difficulty of getting a satisfactory cover. These trials will need to be repeated before definite recommendations can be given.

Bracken fern (*Pteridium esculentum*)

Reports have been received on two trials out of three with bracken fern, and these indicate that pronounced curling of the fronds and "leaves" is all that can be expected from the most effective treatments with hormone weedkillers. From a practical point of view the applications have been useless in the trials considered to date.

St. John's wort (*Hypericum perforatum*)

On one of two trials from which results are available "Weedone" sprayed at normal rates appears to have killed St. John's wort, though "Agroxone" has had little effect. Further trials are required on this weed.

Hemlock (*Conium maculatum*)

Hemlock appears to be susceptible to sprays, particularly of "Weedone," and can probably be killed with the usual applications of this material. "Agroxone" spray is somewhat less efficient, and dusts are considerably inferior. Only two trials have been conducted, however, and further work is required.

Nassella tussock (*Nassella trichotoma*)

As might be expected from a grass of this nature, the treatments so far considered have proved ineffective on nassella tussock.

Periwinkle (*Vinca major*)

Though affected by "Weedone" spraying to a considerable extent, periwinkle appears to make practically-complete recovery later. However, repeat sprayings may eradicate this weed.

Wild portulaca or Curnow's curse (*Calandrinia caulescens*)

Wild portulaca appears to be killed by "Weedone" sprayed at rates of 1 to 2 gallons an acre. Trials have not been made with other materials.

Other susceptible weeds

In various trials good results have been secured with hormone weedkillers on the following weeds: Cornbind or convolvulus (*Calystegia sepium*)—in some cases a complete kill of the extensive rooting system is not obtained with a single spraying; wild turnip (*Brassica campestris*)—all the brassica species are very susceptible; watercress (*Nasturtium officinale*); goat's rue (*Galega officinalis*); fennel (*Foeniculum vulgare*); burdock (*arctium lappa*); tutu (*Coriaria ruscifolia*); and silver poplar (*Populus alba* var. *nivea*).

As these results in most cases have been obtained on only a few trials, they must be accepted with caution until further confirmation of the results has been secured.

Drains and Ditches

Many of the weeds which have been considered are also troublesome in drains, and the results already summarised can be applied to those weeds growing in such positions. Spending considerable sums in the eradication of weed growth in drains by means of chemicals is probably economic, because the cost of the operation must be compared with that of cleaning the drains by hand. In some cases the fact that the sides of the drains are not disturbed by spraying is a considerable advantage.

In general, the growth that can be treated is that above the water level, for prohibitively-large amounts of hormone-type weedkillers are required to kill weeds growing partly or wholly under water. A new class of compounds has been developed for that purpose, but supplies are not yet available for trial in New Zealand.

Trials have been conducted on the following weeds:—

Glyceria aquatica (*Poa aquatica*, so-called)

Glyceria aquatica is a useful plant on poorly-drained land but often becomes aggressive in drains. A trial in the Thames district, initiated by the Soil Fertility Research Station, indicated that sodium chlorate alone had a marked effect on the plant, and then only above the water level.

Watercress (*Nasturtium officinale*)

Watercress is quite susceptible to moderate applications of hormone weedkillers.

Monkey musk (*Mimulus guttatus*)

Monkey musk, which is troublesome in drains in the Manawatu, can be controlled by spraying with "Weedone," the only material used in the one trial carried out. On tall growth repeat sprayings are probably necessary.

Poorly-drained Pastures

Six trials have been conducted dealing with the eradication of buttercup (*Ranunculus* species) and docks (*Rumex* species), two of the commonest weeds of poorly-drained pastures. These trials were at Rangiotu, Feilding, Matakana, Kaipara Flats, Dargaville, and Westport.

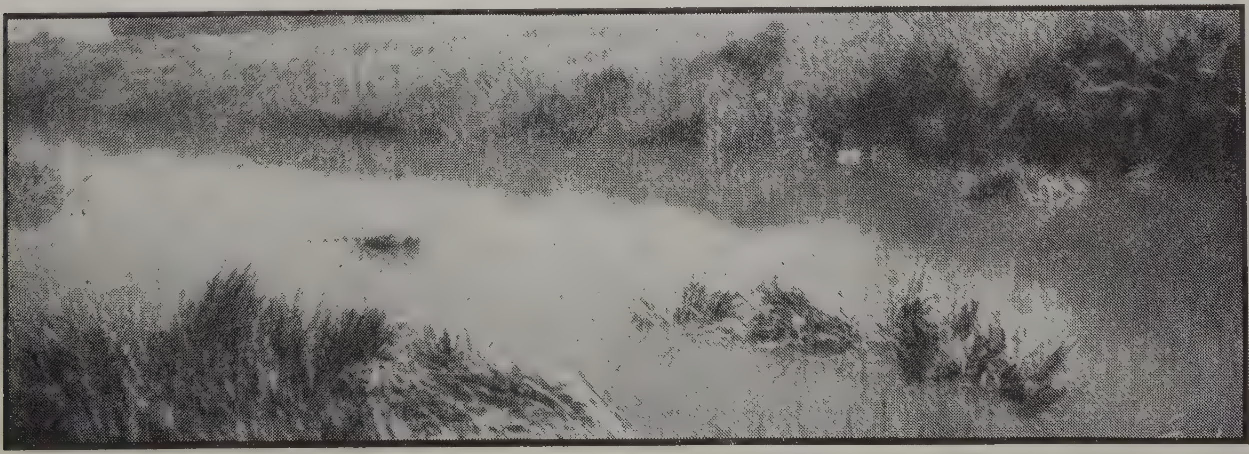
In general, both these plants are susceptible to the hormone weedkillers and can be controlled by moderate applications. Though the dusts are not as successful in securing complete kills as the sprays, particularly of "Weedone," their less drastic action on useful plants would make desirable the use of 2 to 3cwt. of 1 per cent. "Agroxone" dust for eradication of buttercup and docks in pasture. Occasionally the more severe treatments may be required for the elimination of docks.

Nevertheless, the action of these weedkillers is to remove an effect. The more logical treatment is to remove the cause, which in this case is usually poor drainage and poaching of pastures. Only by such means can a permanent improvement of the sward be obtained.

Weeds of Annual Crops

The treating of weeds in annual crops is the section of the work that receives the greatest attention in overseas literature, but in New Zealand it is less important than the problem of weeds in pastures. Nevertheless, crops of relatively-high value can be treated economically with chemical weedkillers if such treatment will improve crop yields to a degree that will cover the cost of treatment. Alternatively, the elimination of weed seeds from seed crops may result in a higher-valued product, which may make weed control with chemicals worth while. Greater ease of harvesting clean crops may be considered in itself a sufficient repayment for treatment.

But clean farming is the most reliable method of preventing weed growth, and too much reliance should not be placed on the



Glyceria aquatica ("Poa aquatica") in a tidal drain in the Thames district. "Islands" of the weed, broken off by tidal action, are floating in the drain. Thus the grass quickly spreads from the area of establishment.

A heavy infestation of tares causing a wheat crop to lodge (Rakaia, 1947). In this instance suppression of weeds would have resulted in easier harvesting, higher yields, and improved quality of grain.

use of chemical weedkillers. Such products are of value where adverse weather or some circumstance beyond the farmer's control has caused a weedy crop.

In general, complete eradication of the weeds is not necessary. A suppression of weed growth so that the crop can "come away" is all that is required. That, together with the fact that the weeds usually may be treated in a susceptible seedling stage, frequently makes chemical weed control in crops feasible.

Such treatment depends on selective action of weedkillers, for crops are not immune from the effect of weedkillers simply because they are called crops and not weeds. Some crops, such as the turnip and swede family, are among the most susceptible plants. Therefore, the following summary of experiments is concerned with the resistance of crops, but the weeds that have been successfuly eliminated will be enumerated in each section:—

Wheat

"Sinox" at 1 gallon an acre (1:100 dilution) at Spring Creek successfully eliminated hedge mustard (*Sisymbrium officinale*), twin cress (*Coronopus didymus*), stinking mayweed (*Anthemis cotula*), and white clover. The wheat was affected, but recovered and gave a clean crop. The grass *Poa annua* was not affected by the treatment. On the untreated plots the wheat lodged because of the mass of hedge mustard present.

A double treatment of "Weedone" on Californian thistle (*Cirsium arvense*) in wheat did not eradicate the thistle but gave beneficial results. New shoots sent up after the first treatment were resprayed, but positive eradication could not be assumed from such double treatment. The wheat was unaffected. The instructor considered that the treatment was practical for small patches of Californian thistle but would probably be too expensive on a large scale.

Much more work of this nature requires to be done, particularly on the effect of chemical treatments on yield. The difficulty of eradicating the Californian thistle in the second case is of interest; possibly the cover afforded by the crop prevented a thorough coverage of the thistle with spray.

Barley

At Tuamarina successful eradication of spurrey (*Spergula arvensis*) and wild turnip (*Brassica campestris*) was obtained with 4cwt. of 2½ per cent. "Agroxone" dust, the barley being unaffected. Though this weed control did not greatly affect the yields of barley, the prevention of seeding of the wild turnip was considered most beneficial.

At Southbridge "Agroxone" and "Weedone" sprays were used at 2⅜ gallons an acre and "Agroxone" 5 per cent. dust at 3cwt. an acre. The most successful treatment was "Agroxone" spray, which killed both wild turnip and Californian thistle without affecting the barley. Where it was untreated the thistle practically smothered the barley. "Weedone" gave a quicker kill of the weeds than did "Agroxone," but the barley was affected to some extent and was later in ripening. The dust treatment did not give by any means a complete kill of Californian thistle.

Barley appears to be more susceptible to hormone sprays than other cereal crops, and it would probably be wise to avoid heavy applications of the products with rather a drastic action. "Agroxone" tends to be more selective in this sense than does "Weedone."

Linseed

Five trials were carried out on linseed—at Tinwald, Weedons, Broadfields, Doyleston, and Taiko. These gave remarkably consistent results.

In all cases "Weedone" spray, even at a rate as low as 1 gallon an acre, was too drastic, a large proportion of the linseed being killed. But "Agroxone" spray, at quantities up to 2 gallons an acre, while effectively controlling weeds, did not damage the linseed to any marked extent, though it retarded ripening considerably. "Agroxone" dust was also successful at the rate of 2cwt. an acre of 5 per cent. dust, though the same rate of 1 per cent. dust did not control Californian thistle.

In effectiveness against weeds the "Weedone" spray was the best treatment, but "Agroxone" gave quite satisfactory results. At this stage, therefore, the only recommendation that can be given is the cautious application of relatively-light dressings of "Agroxone"—say, 1 to 2 gallons of spray or 3cwt. of 1 per cent. dust. Only small areas of the crop should be treated until experience is gained in the use of the material.

In the "Journal of Agriculture" for August, 1946, recommendations were given for the use of "Sinox" on linen flax, and these should apply to linseed as well. Here again the crop is likely to be damaged when only slightly-excessive quantities are applied, as might occur with uneven distribution of spray or under conditions of high humidity within the crop.

Weeds that have been killed in the trials with hormone weedkillers are Californian thistle, fat-hen (*Chenopodium album*), yarr or spurrey, ribgrass (*Plantago lanceolata*), dead nettle (*Lamium album*), sorrel (*Rumex acetosa*) (by "Weedone"), and red dead nettle (*Lamium purpureum*). Redshank (*Polygonum persicaria*) recovered after an initial check, but wireweed (*Polygonum aviculare*) was unaffected at any stage.

Peas

Five trials have been conducted on peas. Three of them were with "Sinox," and results, as indicated in the August, 1946, "Journal," suggested that 1 gallon an acre of this material (at 1:100 dilution with water) may successfully clean peas of many annual weeds, if the weeds are not allowed to grow to a considerable size.

The two trials with hormone weedkillers were at Yaldhurst and Christchurch, using "Weedone" and "Agroxone" sprays. Both of these materials damaged the pea crop, the "Weedone" to a much greater extent than the "Agroxone." Nevertheless, the latter treatment, by effectively cleaning the crop, enabled sufficient growth to come away for a satisfactory yield to be obtained. "Weedone" killed practically all peas sprayed.

Weeds killed were Californian thistle, wild turnip, fat-hen, and docks (*Rumex* species). Cleavers (*Galium aparine*) was not affected at any stage.

Potatoes

Three trials have been conducted on potatoes, at Broadfields, Southbridge, and Yaldhurst.

Both "Weedone" and Agroxone" sprays at rates of about 2 gallons an acre affected the growth of potatoes, but the crop usually recovered satisfactorily. Weeds killed included spurrey, fat-hen, wild turnip, and Californian thistle. Bladder campion (*Silene cucubalis*) was killed down to the minor roots, but the major root system was unaffected and sent forth fresh shoots later.

Carrots

Carrots are remarkably resistant to power kerosene but are susceptible to the hormone weedkillers. Many trials have been carried out with kerosene, the results of which have been published from time to time in the "Journal." In general, a complete weed kill can be obtained, if the weeds are not too large, from an application of 30 to 40 gallons of kerosene an acre, applied in a narrow band along the crop rows. The weeds between the rows can be eliminated easily by intercultivation.

Onions

Onions are susceptible to hormone weedkillers, but after the three-leaf stage are resistant to "Sinox," "Denoc," and sulphuric acid. The results of trials with "Sinox" on onions were given in the "Journal" for August, 1946, and the standard dosages of 1 gallon an acre of "Sinox" and "Denoc" have been confirmed by later experiments. However, these have shown that once the weed growth is allowed to "get away"—say, to 6in. high—the control obtained from D.N.O.C. compounds is unsatisfactory.

Sometimes onions will not have reached the resistant three-leaf stage when the weed growth is in the stage when it can be successfully eliminated by D.N.O.C. sprays. In that case it would appear that the use of sulphuric acid is preferable. This material is, of course, more dangerous to handle, and is most destructive of spraying equipment unless great care is taken.

Beans

Beans are susceptible to hormone weedkillers, and a trial at Riverlands had the unfortunate result of killing the bean crop, while the weed infesting the crop, hoary cress (*Cardaria draba*), though affected, recovered after a severe check.

Summary of Results

This artcle will have shown that the information at present available about the new types of hormone weedkillers is insufficient on which to base firm recommendations for their use. It is hoped that the results of the trials with these materials will indicate their limitations as well as their possibilities and assist farmers in deciding whether to try the chemicals for the particular weed problems they have to face. At the present stage the hormone weedkillers should be used experimentally by the practical man, and not on a large scale unless he is fully satisfied with the results of such investigations.

The following list gives the present stage of knowledge concerning the effectivness of hormone weedkillers:—

Susceptible Plants

Scarlet pimpernel (*Anagallis arvensis*).
Spurrey (*Spergula arvensis*).
Docks (*Rumex* species).
Black nightshade (*Solanum nigrum*).
Fat-hen (*Chenopodium album*).
Sow thistle (*Sonchus oleraceous*).
Scotch thistle (*Cirsium lanceolatum*).
Hawkbit (*Leontodon hispidus*).
Dandelion (*Taraxacum officinale*).
Ribgrass (*Plantago lanceolata*).
Broad-leaved plantain (*Plantago major*).
Twin cress (*Coronopus didymus*).
Winged thistle (*Carduus tenuiflorus*).
Nodding thistle (*Carduus nutans*).
Pennyroyal (*Mentla pulegium*).
Catsear (*Hypochaeris radicata*).
Self-heal (*Prunella vulgaris*).
Cape weed (*Cryptostemma calendulacea*).
Daisy (*Bellis perennis*).
Waxweed (*Hydrocotyle Americana*).
Hemlock (*Conium maculatum*).
Wild portulaca (*Calandrinia caulescens*).
Wild turnip (*Brassica campestris*).
All brassicas—turnips, swedes, rape, chou moellier, etc.
Watercress (*Nasturtium officinale*).
Goat's rue (*Galega officinalis*).
Fennel (*Foeniculum vulgare*).
Burdock (*Arctium lappa*).
Tutu (*Coriaria ruscifolia*).
Monkey musk (*Mimulus guttatus*).
Buttercups (*Ranunculus* species).
Hedge mustard (*Sisybrium officinale*).
Stinking mayweed (*Anthemis cotula*).
Dead nettle (*Lamium album*).
Red dead nettle (*Lamium purpureum*).
Carrots.
Onions.
Beans.

Moderately-susceptible Plants

Redshank (*Polygonum persicaria*).
Sorrel (*Rumex acetosa*).
Californian thistle (*Cirsium arvense*).
Red clover (*Trifolium pratense*).
White clover (*Trifolium repens*).
Clovers in general.
Ragwort (*Senecio Jacobaea*).
Variegated thistle (*Silybum marianum*).
Geraniums (*Geranium* species).
Sweet brier (*Rosa eglanteria*).
Broom (*Cytisus monspessulanus*).
St. John's wort (*Hypericum perforatum*).
Gorse (*Ulex Europaeus*).
Linseed.
Peas.
Potatoes.
Bladder campion (*Silene cucubalis*).
Hoary cress (*Cardaria draba*).
Yarrow (*Achillea millefolium*).

Resistant Plants

Hard fern (*Paesia scaberula*).
Tutsan (*Hypericum androsaemum*).
Mouse-eared chickweed (*Cerastium glomeratum*).
Moss.
Bidibidi (*Acaena sanguisorbae*).
Blackberry (*Rubus* species).
Bracken fern (*Pteridium esculentum*).
Grasses in general.
Periwinkle (*Vinca major*).
Cereals in general.
Wireweed (*Polygonum aviculare*).
Cleavers (*Galium aparine*).

Acknowledgments

A programme of experiments such as that summarised in this article is possible only when the ready co-operation of farmers with the work is available. That such co-operation has always been forthcoming speaks highly for their progressive outlook.

Linseed and Linen Flax

By J. D. WRAIGHT, *Fields Instructor, Timaru.*

BOTH linen flax and linseed, which have come into prominence in recent years to meet requirements brought about by war conditions, have proved very successful crops on some of the arable lands of the South Island. The clay downs to foothill country are most suitable for both crops.

LINSEED and linen flax have been evolved from a common parent plant. Linseed has been bred for its capacity to produce large quantities of high-oil-content seeds. This is achieved by encouraging side branching and minimum fibre content in the straw. Linen flax, on the other hand, has been evolved for length of straw, maximum fibre content, and lack of branching, which would detract from the all-important quality of straw. From the very different characteristics of the two crops it is evident that conditions that may be entirely suitable for one may not suit the other.

Linen Flax

Whether an old lea paddock on lighter land or a stubble paddock of higher fertility is to be sown in linen flax, early cultivation is necessary to bring the land to a fine crumby state in its final cultivation. As quality of straw is required in linen flax, such weeds as fat-hen, yarrow, and cornbind will seriously affect the crop, and cultivation of a paddock selected for a linen flax crop should be carried out with the express purpose of minimising such weed infestation. Paddocks which have grown a fed-off crop should not be sown in linen flax, as the excess of nitrogen after the feeding off of a crop is not conducive to quality fibre. Paddocks which lie away from the sun should also be avoided for the crop, as dark faces do not usually grow the requisite length of straw.

Plants of linseed (left) and linen flax (right).

Sowing may be done late in September and through October, but should not be later than the first week in November. Linen flax seed is supplied by the factory. The rate of seeding, the method of sowing, and the variety to be sown are advised by field agents of factories contracting for the purchase of the crop.

Growers are strongly advised to use Holland coulters, which are available from all linen flax factories.

Linseed

Linseed does not require such exacting conditions as linen flax, and paddocks which have been in fed-off crops or which are ploughed out of clover are very suitable.

Cultivation for a payable linseed crop should be thorough and areas intended for the crop should be ploughed early. The presence of weeds will not affect linseed as it will linen flax, as linseed can usually outgrow average weed growth.

Sowing may be done between the latter part of September and about the end of the first week in November. As early sowings result in harvesting being carried out during the better weather, every effort should be made to have linseed sown in good time. The rate of seeding is usually 35lb. to 40lb. an acre of high-germinating seed, but these amounts will have to be varied according to the variety used. Varieties which have shown promise in Fields Division trials are Bison, Walsh, and particularly Golden Viking. These have outyielded varieties such as Rio and N.Z. Commercial.

Seed Maize

SUPPLIES FOR 1947 SOWINGS

THE appeal for increased maize production made a year ago met with a gratifying response, and at its last meeting the Maize Marketing Committee considered the allocation of an estimated crop of 100,000 sacks of grain, an appreciable increase on the 58,000 sacks allocated from the 1946 harvest.

IN all over 2000 bushels of seed of Pfister Hybrid No. 360 type—sufficient to sow 8000 acres—was marketed during 1946. A portion of this seed was Government Approved, having been grown under contract by the Department of Agriculture.

To further the policy of the Department concerning the supply of seed maize of hybrid types, the produce of a second area sown out under contract in the 1946-47 season will be available for distribution in time for 1947 sowings. The seed used for sowing this area was supplied by the Pfister Hybrid Corn Company, so that the seed the Department will shortly be marketing will be the once-grown product of the genuine hybrid itself. This is in contrast to the seed released last year, which through force of circumstances was several generations removed from the genuine hybrid material.

Trials laid down by the Department last season, while not yet completed, clearly indicate that loss of hybrid vigour with consequent lower yields takes place as succeeding generations become further removed from the genuine hybrid material. Conversely the seed available for distribution this year will have better inherent yielding qualities than that distributed last year, and users of this seed may expect improved yields from crops planted with the new season's seed, subject, of course, to the effect of seasonal conditions.

The seed available for distribution will be supplied in sealed one-bushel bags through the usual mercantile firms operating in the maize-growing districts, and farmers intending to buy this Government Approved seed should make their requirements known to their usual merchant.

Following up preliminary work in the past season, the Department has made plans to produce the genuine hybrid seed itself in the 1948 harvest. This seed, the product of controlled pollination similar to that used in America to produce hybrid seed corn, will inherit the maximum benefit to be derived from hybrid vigour.

J. H. CLARIDGE,
Agronomist, Wellington.

THE PLANTING OF HOMESTEAD SHELTER

By M. SUTHERLAND, *Farm Forestry Officer, Rural Development Division, Wellington.*

THE adage of the old Scots laird that "Ye may be aye stickin' in a tree, it will be growin' when ye're sleepin'," is excellent advice for the New Zealand farmer, but a little more than just "stickin' in a tree" is required to get the best results even in this country's comparatively favourable conditions for planting. In some soils and districts successful planting is a simple, straightforward operation with little risk of loss; in others, because of the difficult nature of the soil or a severe climate, special methods must be used. The simplest procedure in planting is the best to use when it will achieve success, but where conditions are difficult it is better to use methods which under normal conditions would be condemned as uneconomic or too meticulous.

IN establishing any degree of shelter around a homestead, whether it consist of several plantations or merely of a row of trees, the same stages must be gone through, from the provision of fencing down to the final blanking up of failures in subsequent years.

Protective Fencing

All land to be planted in trees must be fenced off from contact with stock. Given access to growing shrubs or trees, sheep will browse off the green tips and prevent further growth; cattle will not only browse tips but will snatch at branch ends and probably tear them off, damaging the bark of the main stem; and horses—perhaps the worst offenders—will eat small branches as well as tearing bark off a tree trunk. Damage to the bark of a growing tree may impede growth and will cause scars which may provide entry for rot-causing fungi.

On large farms where use of land need not be restricted the enclosure of wide strips for shelter is no hardship, but on small holdings, where every acre counts in production, reservation of a proportionately large area for tree growing alone may be regarded as wasteful. In such cases it is better to make a few belts with generous margins than to attempt more shelter and, by being niggardly with a fencing margin, run the risk of destruction and failure of the whole shelter system.

For successful maintenance of belts fences must be placed at such a distance that stock cannot reach over and browse on the trees. The distance required depends on the species of tree, its rate of lateral growth, and its reaction to the trimming of the end growth of branches. Such species as pines, or deciduous hardwoods like beech and oak, shed their lower branches as age increases but for a time can be encouraged to retain leafy branches by light trimming of the tips, as a result of which they sprout laterally and form a leafy screen. That is the principle of hedge trimming and can be applied to *P. radiata* or *P. muricata* to form trimmed shelter hedges, but with those species the light trimming must be continuous and accompanied by an initial topping to stop the height growth of the main stem. With careful manipulation it is possible to allow such shelter hedges to grow toward the fence to a definite lateral distance and to maintain the foliage there by the trimming done by stock at their extreme reach. Lawson's cypress retains its branches to the ground and answers well to this treatment, as the natural form of growth produces prolific lateral branchlets; as long as only growth tips of 6in. or so are removed no harm is done to the tree and a dense canopy is formed.

It is necessary to allow for the longest reach of grazing stock plus a further distance according to the lateral growth of each species, and it will pay in the long run to allow too much rather than too little room. The following table gives suitable minimum distances to be allowed between fences for single-row shelter belts and the minimum distance between tree and fence which should be allowed in multiple belts when the outside row is of the species named:

	Width of planting strip. ft.	Distance of fence from nearest tree. ft.
Pinus radiata	20	9
Cupressus macrocarpa	20	9
Other pines	16	8
C. Benthamii	16	8
Lawson's cypress ..	18	9-10
Deciduous trees with a hedge at the base ..	10	5

PLANTING HOMESTEAD SHELTER

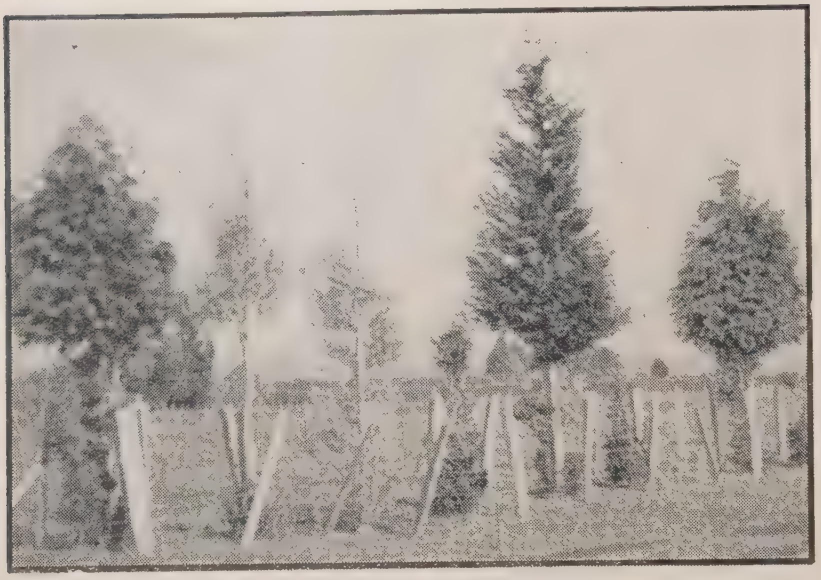


Fig. 1—Fences were too close and faulty and stock have reached over and destroyed this shelter belt.

Native species on the outside of a shelter belt do not appear to be so badly damaged by stock as do exotics, and though browsing makes them unsightly, their tenacity of life is strong and they may persist with fencing closer. Lawson's cypress, a slower-growing tree, should be given slightly more room to spread because, if space will permit of its being treated as a single tree, it will remain clothed to the ground until it matures and may safely be left untrimmed, in contrast to *C. macrocarpa,* which produces heavy and strong open branches likely to overshade and kill out a neighbouring species planted too close to it. *C. Benthamii,* on the other hand, tends to produce straggly side branches and its shelter value is increased if its spread is confined by early tip trimming.

The space occupied by hedges round the house or garden enclosure varies with the species. In this position double fencing is not required, so it is only necessary to be careful that the plants are put in at a distance from the fence sufficient to prevent their being touched in early growth by stock stretching over or through it, plus half the ultimate width of the species. In general a minimum distance of 4ft. should be allowed.

Preparation of Land

When planting homestead shelter it may be necessary to develop shelter belts on areas which are covered by weed growth or scrub. In the vicinity of the house clearing the land by cultivating may be difficult and it will not always be desirable to stack and burn the rubbish. In many cases, however, and in windy areas, such a land covering will be no disadvantage. Manuka, for example, gives protection from frost and excessive sun and many species thrive under its shade. For ease of planting on a large scale in high manuka growth, lines may either be cut or opened up by knocking off side branches with stout staves. In burnt manuka areas no line clearing is necessary.

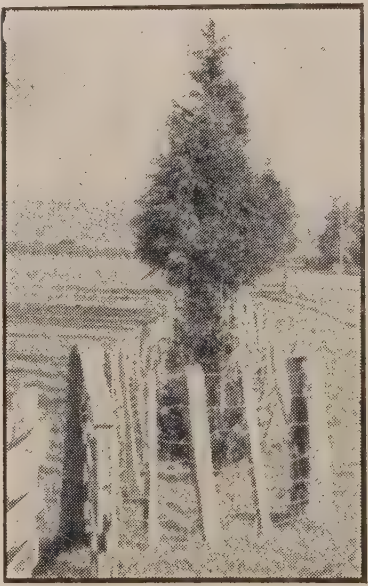


Fig. 2—Niggardly use of land allowed only 8ft. between fences and has resulted in the ruin of these shelter trees.

Strong growth of blackberry is chiefly a disadvantage to the planter, and most trees or shrubs will survive to grow through such cover. Heavy fern growth is perhaps the most inimical to tree growth, and such areas should be cleared before planting is attempted. The fern should be cut or burnt some weeks before trees are planted, and after a good burn the first year's regrowth will be too thin to overshade newly-planted trees.

When trees are being planted in pits or notched on uncultivated land weed growth should be cleared around the spot to give planted trees more chance to grow strongly. However, where open, straggling scrub growth exists it is best to retain it and plant the new trees in the lee of a bush where possible.

A good fibrous root system increases the rate of growth of trees—an especially-desirable feature in shelter belt species. Extensive rooting is encouraged in well-cultivated land, so it is important to cultivate well the soil on which trees are to be planted for shelter. The amount of cultivation necessary depends on the type of soil and the method of planting.

The most economic method is that which gives a successful strike with the least expenditure of labour. Though some years ago it was a standard practice to dig pits to receive the trees, with increased knowledge of growth other less laborious ways have been used with success. Such methods involve either spot cultivation (as with mattock planting), ploughing a double furrow, or cultivation of a strip of land the width of the belt to be planted. In general it is best to carry on this cultivation at least a few weeks before planting so that the ground may resettle and form a firm bed. In heavy land or clay soil it is an advantage to cultivate some months before planting, preferably before winter, so that the frost may weather the exposed soil before spring planting is started in it.

Methods of Planting

For homestead planting probably a combination of ploughing and planting methods is best, at least for extensive tree belts. For larger or specimen trees planting in prepared pits reduces the risk of failure.

Notching and Furrow Planting

Perhaps the simplest method of tree planting is notching, which may be combined with furrow ploughing. The procedure is to plough a single or double furrow, according to the width of strip required, along the proposed line some weeks before planting so that the soil may settle again. That produces a clean, broken soil surface in which the trees may be planted by notching.

To notch in a tree make an L-shaped cut at least the depth of the spade blade, drawing the soil forward. Insert the plant between the firm angle of ground and the blade so that the roots are spread out and hang at their full length. As the spade is carefully withdrawn press the soil or turf back into place against the roots and tramp it down firmly.

In free soil (not clay or sand) a T-shaped cut may be used, but care must be taken not to thrust the plant into the opening and bend up the roots. In stiff clay soil this cut is not good because the soil may open up along these lines when it shrinks in dry weather, causing the roots to become dried out. Notching is most suitable on pumice soil or in a light, free loam, which has good natural tilth and, because of its good drainage, is not easily made unworkable by rain.

T-notching is not possible in sand and pit planting is unnecessary, so a compromise between an L-notch and dibbling is the best method to use on sandy areas.

Furrow planting can best be used for the establishment of hedges or single-row belts, but where multiple belts are required, or where an area is to be devoted to large specimen trees whose growth must be hastened, a great advantage is gained if all the ground is given a regular, deep, previous cultivation, as the subsequent growth is much greater. In some regions advantage may be taken of this preparatory cultivation to raise a vegetable crop between the tree rows in the first year, and that is an excellent plan when planting around the house, especially in the early stages of farm development, when time and labour can be saved by combining the operations of shelter and vegetable growing.

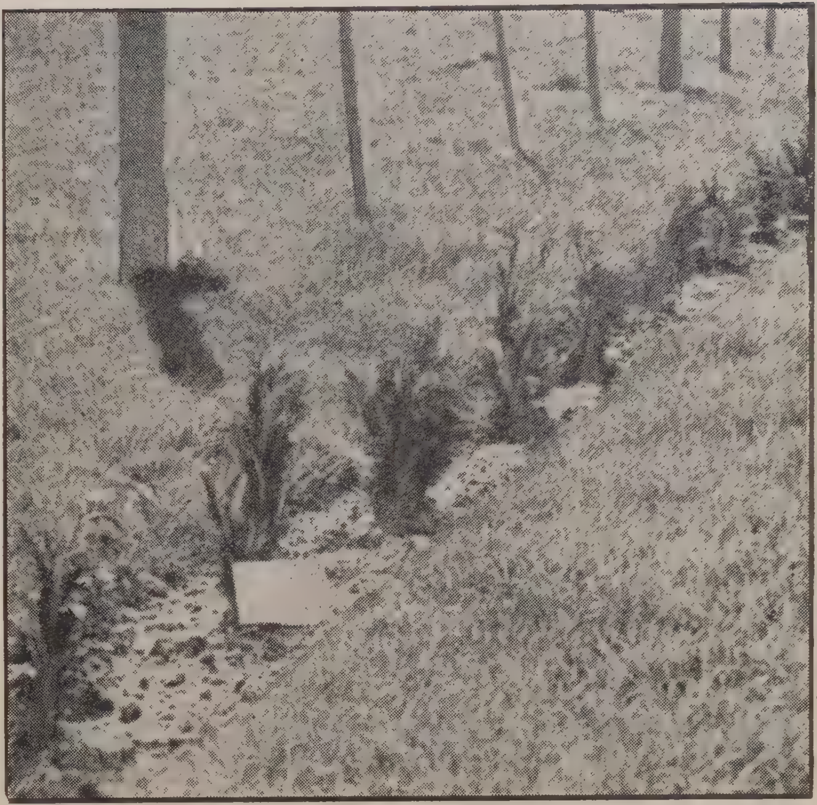


Fig. 4—Lawson's cypress single-row shelter belt planted on a cultivated strip.

Fig 3—Native species along the fence are not harmed by stock.

Notch planting may be used directly on uncultivated land or in turf, but in both these cases the trees must struggle against weed growth and do not have the clear start that is given in cultivated land; consequently growth is slower. In turf there is also danger of the trees losing in the competition for moisture, which in areas of summer drought is another reason for using pre-cultivation methods.

Pit Planting

Only local cultivation is used in pit planting, which consists of digging a small pit, inserting the tree in the centre of the hole, replacing soil around the roots, firming the plant in the ground, and filling up the pit to ground level again. In windy districts it is better to place the roots

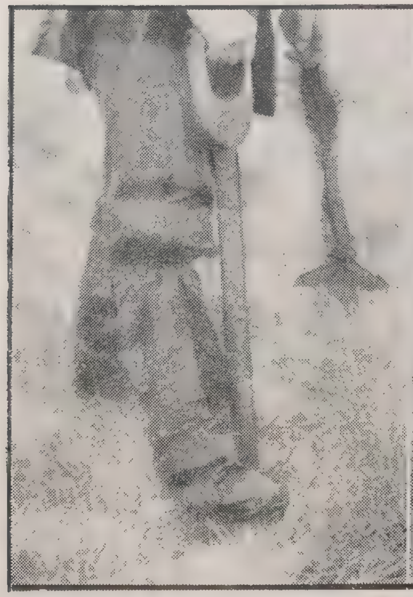


Fig. 5—Make a first cut to the depth of the spade.

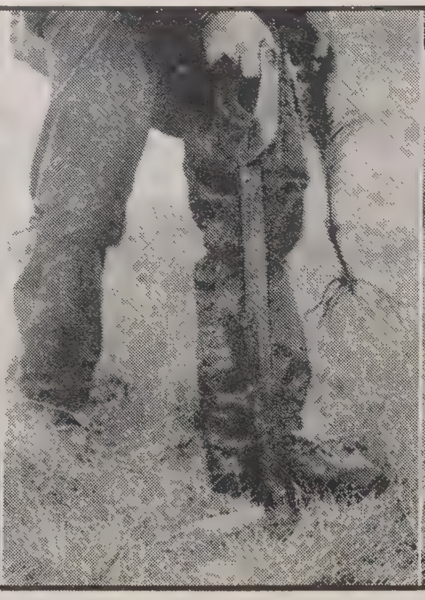


Fig. 6—An L cut is made. The rule marks the first cut.

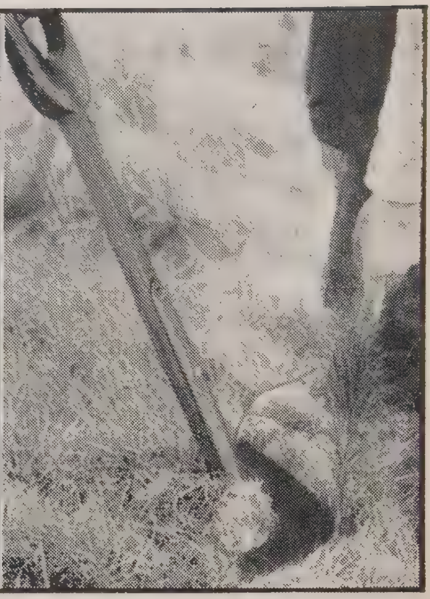


Fig. 7—The spade is pulled back and the tree inserted at the angle of the cut.

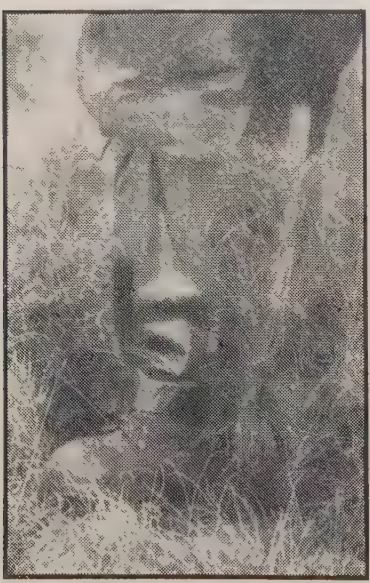


Fig. 8—The earth is pushed back and firmed with the foot.

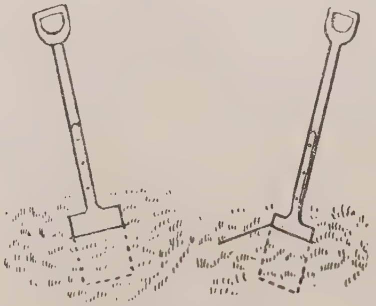


Fig. 9—How to make the L cut for notch planting.

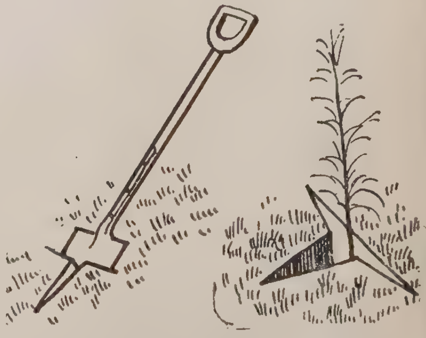


Fig. 10—The T-shaped cut for notch planting.

against the side of the pit opposite to the direction of the prevailing wind so that the tree will be supported while anchoring roots grow out into the loose soil.

If the pit is dug in turf or in poor soil, the grassed surface should be scurfed off and discarded or the sod reversed, well cut up with a spade, and replaced at the bottom of the hole to rot. The best portion of soil should be used around the roots, the subsoil being used as top filling, allowing it to become aerated and form humus.

The pit should be at least 9in. square and 9in. deep for small seedlings or trees, and larger for balled plants—for large specimens at least 6in. beyond the diameter of the ball, in which case it is advantageous to collect good soil from elsewhere to fill in the lower part of the pit. After the first shovelful of filling and before the soil is firmed the tree should be pulled up slightly to straighten the side roots and allow soil to settle between them. The plant should then be firmed by pressing down the soil with the foot until the plant cannot be withdrawn easily, taking care not to bruise the stem with an iron-shod heel. In sandy or loamy soil this action should consolidate the soil, but if the tree is being planted in wet clay the pressure should be lighter to prevent the soil packing and setting when dry, stopping aeration and the penetration of moisture to the roots. The surface is left rough to absorb rain.

A form of pit planting is used when the whole area is cultivated and trees are planted in a hole made by removing two or three spadefuls of earth, but in that case there is no difference between the soil which is filled in and that surrounding it. This method is not favoured by planters in windy districts where the soil is wet all winter, because the soil remains soft and wet and the small tree blows round loosely in the hole and does not anchor itself sufficiently to start root growth. In such situations many farmers prefer to notch plant trees directly into firm, uncultivated ground, even though they may sacrifice ra-

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Illustrations on this page from photographs by Green and Hahn Ltd.

pidity in early growth. Alternatively, if a tractor is used to cultivate, it may be returned along the line later with one wheel on the furrow to be planted and thus act as a roller to firm the planting line.

In dry, stiff ground, pits should be prepared in autumn and the earth left at the side of the hole in large clods to weather down with frost; if it is broken up too finely, it becomes packed and unaerated by planting time. Soil which cakes easily and cracks when dry should be broken down to a fairly-fine tilth at planting so that when the pit is filled in no air spaces are left round the roots.

A disadvantage of pit planting in rainy regions is that pits dug in advance may become waterlogged in winter if the soil is heavy. If trees are planted when the pits are still in that condition, a high death rate is probable, as the trees must remain with their roots in the water and cannot form new fibrous roots in time to feed themselves before the growing season starts. Where pre-pitting is used in such circumstances the bottom of the pits should be broken up with a mattock or spade just before planting to allow drainage, and it may be necessary to carry round a bucket with extra humus soil from elsewhere to be put in the bottom as a first operation in planting.

For the planting of avenue trees or specimens around the house where furrow planting is not feasible pit planting is preferable, as the pits can be adjusted to the rooting systems of different species—for example, some may have long taproots to accommodate and others bunchy masses of short, fibrous ones.

In rocky or stony hill land a pick mattock is best used to open the ground, the blade acting as the spade and thus making a modified pitting operation where a spade will not penetrate.

Dibbling

In sandy soil or very light loam trees may be planted by using a pointed spade with which a hole is worked in the soil to the depth of the root, the seedling placed in carefully, and firmed by inserting the dibble at an angle near the hole, levering the soil against the seedling to fill in the hole. Very often in sand it is necessary to firm the plant further by tramping. This is a rapid method, but it must be done skilfully to be successful and its use is confined to light soils.

Marking Out the Area

On a furrow or prepared strip there is little need to mark the spots where trees are to be planted. A measuring rod cut to the required distance between plants will do all that is needed,

PIT PLANTING OF SHELTER TREES

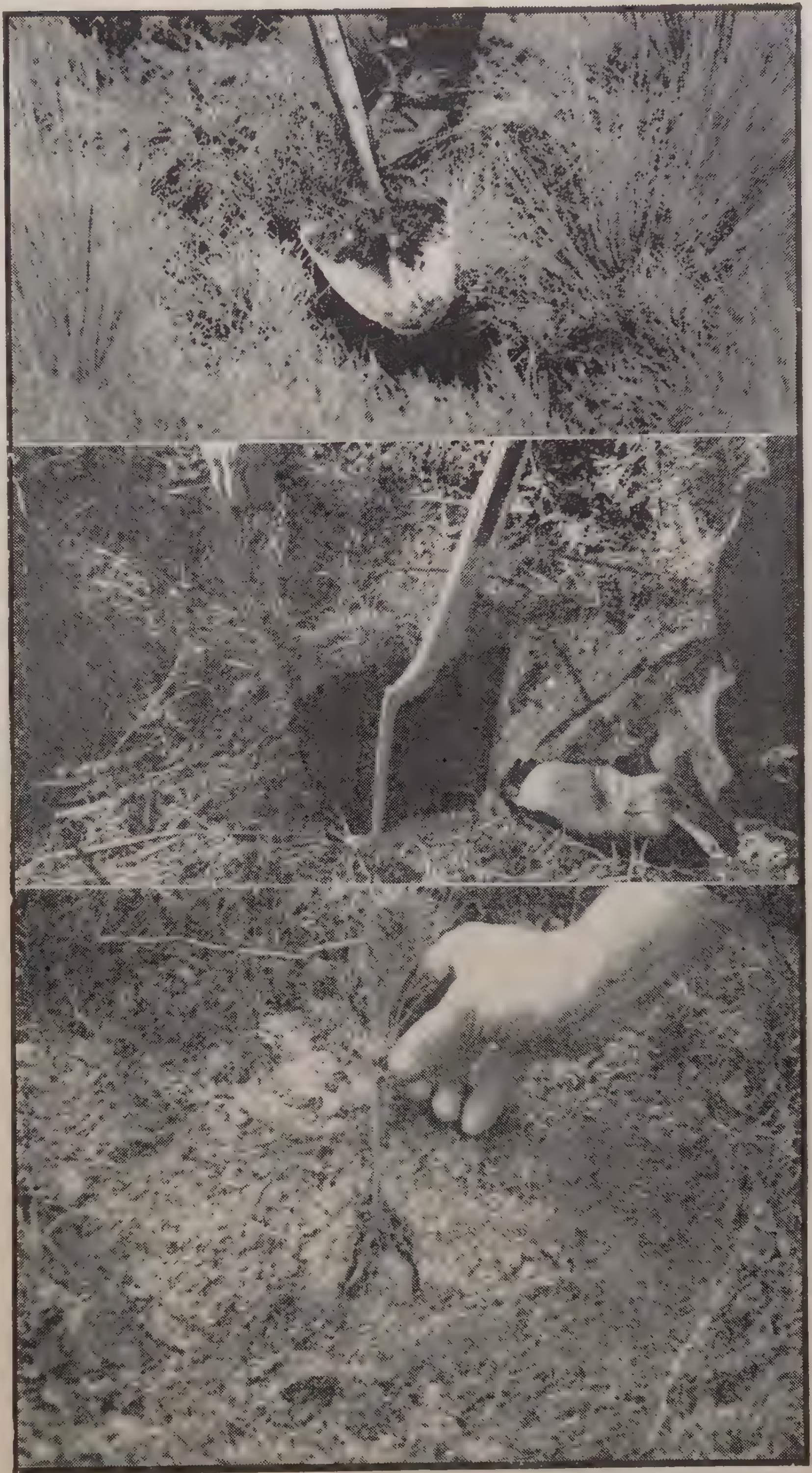

Fig. 11 (upper)—The turf is first scurfed off. Fig. 12 (middle)—The pit should be at least 9in. square and 9in. deep. Fig. 13 (lower)—Tree roots spread out against lee side of pit, with the "collar" just at surface level.

Upper and lower illustrations at right from photographs by Green and Hahn Ltd.

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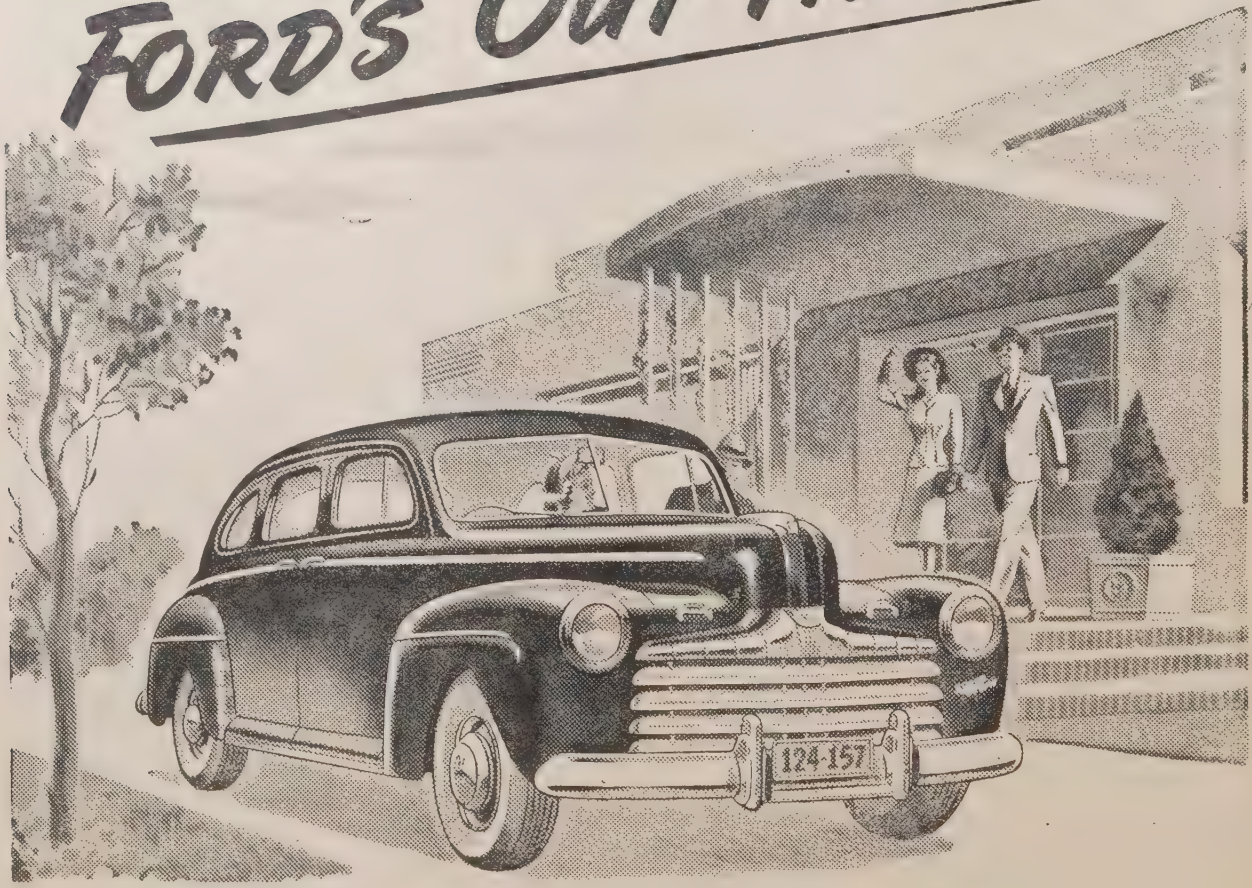

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and if two or more rows in one belt are required, high stakes placed at intervals along the planting lines can mark the row spacing, supplemented by the use of a measuring stick to give tree distance.

However, if irregular spacing has been planned, as in group planting or a shrubbery, it is a good plan to stake out on the ground the spots which are to be planted according to the working plan. By using slightly-different kinds of sticks for different species it is possible to map out the area, and then at any odd time a few trees can be planted without the trouble of consulting the plan on each occasion.

When planting a shrubbery it is possible by this means to get some idea of how the layout looks on the ground before opening the soil. If the considered positions for ultimate spreading specimen trees are marked, there will not be the same temptation to close up distances on second thoughts at planting time.

Season for Planting

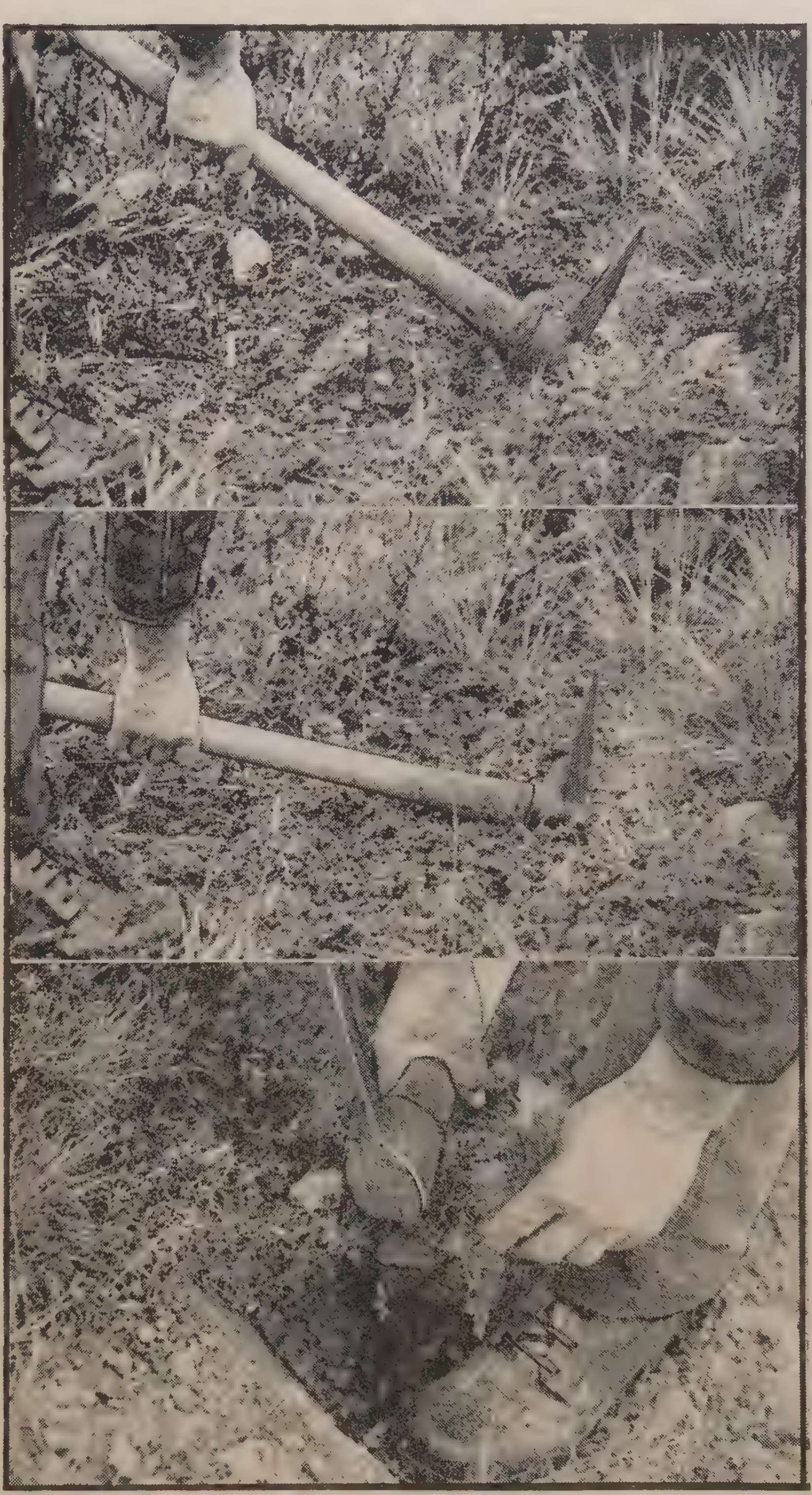
As New Zealand extends over 13 degrees of latitude and the altitude of occupied land ranges from sea level to about 2000ft. above, with all the accompanying seasonal vagaries of climate, it is difficult to state precise months for planting general shelter in definite localities, and it is possible only to point out the principles involved in deciding the best time to plant trees on the farm.

In general, trees may be planted between May and September. In the South Island that period may be prolonged to the end of September, and during June or July soil and weather conditions may make it advisable to stop operations. In localities of the North Island subject to early drying winds prolonging operations beyond August may be dangerous.

Good planting conditions depend much on the state of the soil. If ground is likely to be frost bound, planting trees in late autumn is no use, as they will not be able to develop a root system and absorb food before the winter becomes severe. In soils liable to waterlogging in winter planting must be delayed until spring. On pumice land and in free loam soils, on the whole, soil conditions permit planting all through autumn, winter, and early spring. In heavy or clay soils operations should be left until the land begins to dry in spring. In light, sandy soils planting is best done in late autumn and winter before there is danger of the soil drying out.

Frosty seasons should be avoided and spring planting may be safest, but in areas where dry conditions start early in the year—for instance, on sandy loam in the North Island and parts of Canterbury—it is best, other factors being equal, to plant in autumn

MATTOCK PLANTING OF SHELTER TREES



[Green and Hahn Ltd. photos.

Fig. 14 (upper)—After turf and weeds have been cleared off the soil is broken up with the mattock. Fig. 15 (middle)—Opening a straight-backed cut. Fig. 16 (lower)—The tree is inserted in the angle of the cut. The soil should be left rough round the plant to prevent it packing.

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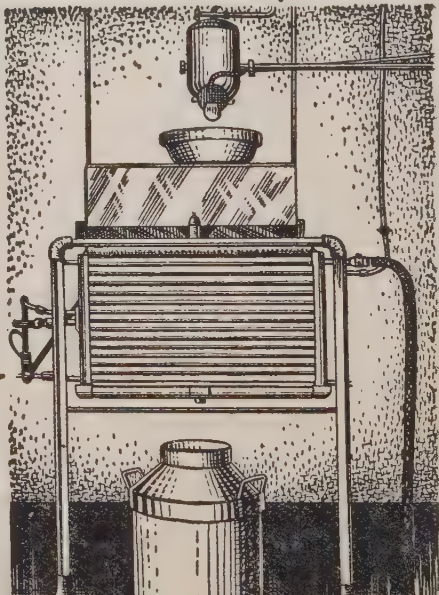

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or winter so that all plants may become established before the soil dries out. Trees or shrubs should always be planted when the soil is moist and warmed by the sun, but preferably in cool, damp weather. Seasons in which prolonged drying winds prevail, usually late spring, should be avoided. In areas of continuous strong winter winds planting is best postponed until they subside in spring; otherwise the young plants must stand the buffeting through the winter with little chance to grow new roots or form top growth.

In almost all districts are low-lying patches of cold land where free circulation of air is arrested and frost persists. These frost hollows should be avoided if possible in planting shelter belts, but if they must be included in a windbreak, it is best to try to grow some kind of cover on the ground and to use frost-resistant trees on these spots. *Pinus radiata* will not grow in frost hollows, but *P. ponderosa* or *P. Murrayana* can persist and grow slowly in such situations. If the use of these species is not feasible, the best way to deal with the gap is either to plant cuttings of *Salix caprea* (goat or pussy willow) 2ft. to 4ft. long in early spring, 2 or 3ft. apart in a group, which will grow to 5 or 6ft. high and fill the base of the gap; or to transplant small manuka bushes or sow manuka seed on the spot in spring. If any other native scrub grows in the frost hollow, it should be preserved; a light hand cultivation of the surface around the roots would encourage its growth and help to dissipate the persistent frost influence.

Altitude affects planting operations only to the degree that it influences the weather. There is little frost danger at sea level, and probably moister conditions with less extremes than on hill areas, but in high country, especially in the South Island, snow lies in winter and prevents planting—though snow is not harmful to trees—and planting weather comes later than on the flat. Perhaps the best time to plant is when this task fits in best with other work on the farm, at the same time complying as far as possible with the conditions discussed.

Planting Stock

Young stock for planting shelter can either be bought from a nursery or raised on the farm. Whether the farmer who wants to do considerable shelter planting is better to grow his own trees or not is a moot point. On a newly-acquired bare farm where a short length of shelter belt is all that can be attempted in one year, and consequently only a small number of trees is required, it would probably be better to buy nursery-raised stock; most likely it will have been grown under better conditions than can be contrived on a new farm, and the farmer's time will be saved. But on farms where shelter planting is well established and stock is required each year for extensions the progressive farmer may well prefer to put a certain amount of time into raising his own stock. Bought stock must be subject to considerable handling before delivery on the farm, with the chance that trees may get dry en route, but stock raised on the spot is there ready to be transplanted and suffers the minimum of exposure. Transported trees should be planted immediately after receipt, whereas with stock grown in the farm garden a few may be lifted and planted at any convenient time. Bought-in stock is usually graded in sizes before being sent out from the nursery, and planting on that basis makes a more finished job. On the other hand, home-grown stock is acclimatised and, especially in high areas or those with a tendency to frost, buying in trees which are not sufficiently hardened off brings risk of failure. When using bought stock it is wise to deal with a nursery in which climatic conditions are similar to or more severe than those on the farm.

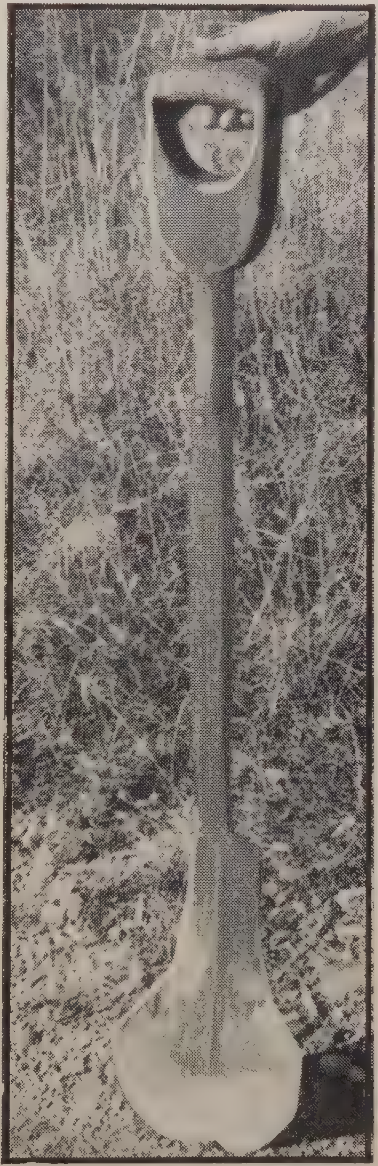


Fig. 17—A tree-planting spade made from an ordinary garden spade.

Some species, such as some eucalypts or trees grown in trays, are grown by special treatment in the nursery, and as they require attention at the busiest time on the farm it is less trouble to buy such stock. To raise a small number of plants the value of the farmer's time may be proportionately high, but where considerable numbers are used annually, and raising becomes a routine job of the farm, there is less immediate outlay, except in labour cost, than in purchase.

Three types of planting stock are required for homestead shelter: Small tree plants for belts or shelter plantations; larger, better-grown specimens for avenues and shrubberies or for shade trees; and stock for hedge planting. The trees may be seedling stock or transplants—that is, seedlings which have been transplanted into nursery lines for one or more seasons to develop a good root system and increase in height; these are known as 1 + 1 or 1 + 2 transplants according to the time they remain in seed-bed or transplant lines. Certain species, such as *Pinus radiata*, grow quickly in their first year in the seed-bed, but to produce the many fibrous roots which enable the plant to start growth more easily when removed from the nursery to a permanent position the seedlings must be wrenched. This is a form of cultivation carried out in the nursery stage to increase root growth, and particulars of the process will be given in a later article on raising planting stock on the farm.

P. radiata for belts is best planted as nine months or one-year seedlings of 9 to 12in., which have been wrenched once or twice. If bigger trees are required, as for planting in rough ground among weeds, blackberry, or gorse, the seedlings may be left for another six months in the nursery lines and given more wrenching. Plants of this species which are required in larger sizes need special care and treatment to be successful when planted out. Other pines and Lawson's cypress grow more slowly and may be used as two-year seedlings or as transplants.

Species which are difficult to transplant, such as *Cupressus macrocarpa*, may be pricked out into boxes or cardboard cups and transplanted direct from these when 9in. high, or can

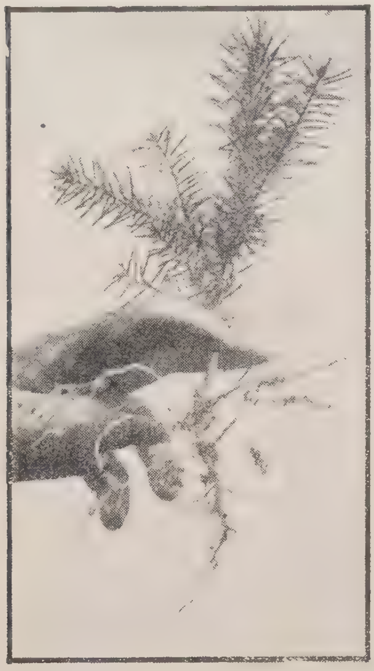


Fig. 18—A well-rooted transplant of Oregon pine.

be transplanted into nursery lines, well wrenched, and used as one-year or two-year transplants up to 15in. high. Eucalypt species require special conditions for successful germination. Most of them are frost tender and do not transplant easily, so that a special form of cultivation is necessary. They may be obtained for planting either in trays like macrocarpa or as specially-treated, open-rooted seedlings. The growing of eucalyptus nursery stock will be described in a subsequent article.

Whatever the species or kind of stock used, the best type of tree to plant on ordinary, clean areas is one which is not too large—9in. to 1ft. high—with good development of fibrous roots and a well-balanced, stocky crown. Too small rather than too large plants are preferable, as they will stand the shock of transplanting better, but where the ground is dirty a taller, stronger tree is necessary to compete with the weeds; plants up to 1ft. 6in. high can be used successfully if the roots are equally well developed. In windy or hilly areas or in very dry country the smaller tree is more likely to succeed, because for sustained growth the amount of water given off from the shoot must be less than that absorbed by the roots, which must be sufficiently fibrous to counterbalance by absorption the excessive quantity given off in transpiration by the leaves.

Specimen trees, either conifer or deciduous, if bought in, may with advantage be obtained as balled trees. Usually not many are required and, though they are more expensive than open-rooted trees, there should be little chance of failure in planting. The standard of purchase for these is size of top rather than age, as the nursery treatment they are given involves a series of checks to foliage production, but is accompanied by root increase.

In carrying out a planting plan it is necessary first to measure the length of single planting rows to be dealt with during the year and calculate for each species the number of plants necessary, then to decide on the type of plant to be used and the approximate month in which it is proposed to carry out the work. Then order stock from a nursery as early in autumn as possible so that the most suitable type of plant for the purpose may be reserved. For example, *Pinus radiata* may be required for one row of a mixed shelter plantation, to be planted 9ft. apart, requiring seven trees to each running chain. These plants could be of minimum size if the ground has been cultivated beforehand and is clean, but if they are for outside trees, they must make a quick start, and one-year seedlings 12in. high may be used. They will increase in height from the start.

The following table will assist in calculating the number of trees required:

Distance apart. ft.	Trees required to plant 1 running chain	Trees required to plant 1 acre
4	16	1722
5	13	1742
6	11	1210
7	9	889
8	8	680
9	7	537
10	6	435

Treatment of Stock During Planting

A basic rule in all planting is to prevent roots getting dry before they are safely in the soil. A good nursery sends planting stock with roots well wrapped to prevent their drying out, but as soon as they are received the parcel and the bundles of plants should be opened to prevent their heating and rotting. The plants should be laid thinly with their roots in a shallow trench in the shade, covered with soil and lightly tramped; they can remain thus safely for weeks without danger of the roots drying out, though it is not good practice to leave them so long. Only a few trees should be removed for planting at a time, and they should have their roots protected from drying winds by being wrapped in an old sack or carried in a bucket. If extensive work is in progress, a special apron may be made from half a sack and suspended conveniently across the shoulder, leaving the hands free to

Fig. 19—Trees heeled in in a damp spot near the planting site, with transplants in the planting bag ready for planting out.

work. If drying out is feared, the trees may first be "puddled" by dipping the roots in a liquid mixture of cow manure, clay or silt, and water, which will form a coating over the fine rootlets.

The important points in planting all types of trees are:—

1. Trim off straggling roots but do not bend up the roots, especially a taproot, when inserting the tree in the soil. That is especially important when planting for shelter, as a root bent at right angles persists thus throughout growth and ultimately may act as a lever in uprooting the tree in heavy wind.

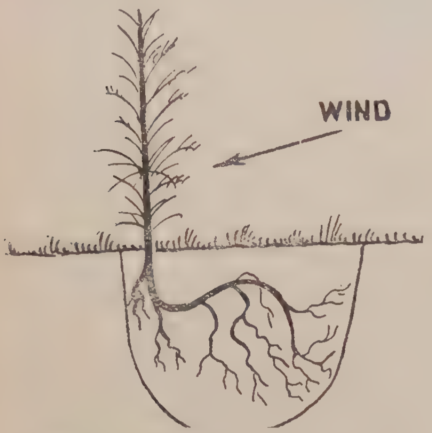


Fig. 20—Doubling up the roots in pressing a tree into too shallow a hole renders the tree liable to wind damage later.

2. The trees should be planted so that the "collar"—that part of the stem which was at the soil surface in the nursery bed—is at the final level of the ground; a little must be allowed for the sinking of the filling-in soil. For firmness in shelter planting slightly too deep planting is better than too shallow planting, but when planted much too deeply the tree may not thrive because it has to use its energy to try to produce new roots near the surface.

3. The surface must be firmed by tramping so that the plant cannot be pulled out of the soil easily. If that is not done the tree is not wind firm and the soil may not be sufficiently compact to prevent the roots drying out.

4. Soil must be in contact with the root tips and therefore should be broken up finely enough to prevent large air spaces being left between earth clods. In pitting, especially in wet areas, the soil should be filled in slightly above ground level or water will collect in the hollow and the plant will suffer from "wet feet" and be unable to grow new roots.

Newly-planted trees may have to be protected from weeds or from animals. In ploughed ground there is little danger of young trees being overgrown; the annual weeds forming on such ground are not usually a menace, but if couch grass grows heavily, it may have to be cleared from around the trees during the first year. Overshadowing from bracken springing up is best prevented by beating down or trampling the young shoots when they are tender, for if left until it has made a heavy cover it will be necessary to free the tips of the trees from the bracken; even with *Pinus radiata* that may be necessary once, as, in spite of its rapid growth, this tree demands light and suffers under the heavy shade of fern, though it can hold its own against gorse or blackberry. Lawson's cypress can persist and grow through weed growth, except fern, though damage is prevented if the tips are kept free. Strangling weeds like convolvulus, honeysuckle, or native creepers should be cleared from around young trees.

With the increase in the rabbit population in many hill areas the danger of rabbit damage to young planted trees has increased. Rabbit fencing being in short supply, the farmer will have a problem to solve if he embarks on his shelter planting in an infested area. For planting of special trees around the house some protection may be given by loosely coiling old barbed wire or even ordinary wire mesh round the small plant. For bigger trees the use of open kerosene tins placed around the stems may help; even cardboard containers or newspaper can be used as deterrents for a short period.

In forest planting no large-scale attempt can be made to support the newly-planted tree against wind, so small plants are used where such conditions prevail, but in shelter planting for the homestead when the situation and climate allow it is best to use bigger plants, as they save some time in growth, provided the necessary precautions in planting and after-care are taken and they are staked.

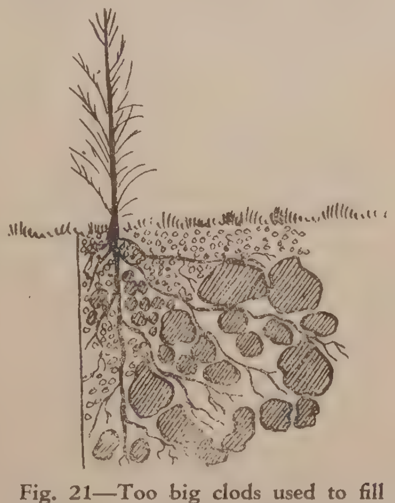


Fig. 21—Too big clods used to fill in round the roots produce air spaces in which the roots dry up.

However, in many windy districts, such as the open country of the Manawatu, though it may not be a necessity, some farmers prefer to stake the young trees, though they are small, until they become established in the soil and produce sufficient anchoring roots. In doing that care should be taken, as with other plants, to insert the stake alongside the main stem, but without damaging the roots, and to tether the plant fairly low on the stem so that no leverage can be exerted by the stake; if necessary, a second tie should be made three-quarters of the way up the plant. The stake for soft-headed species must reach to the tip of the tree, and a string tied in a loose loop will not damage the soft bark of the transplant, even if it is of sapling size in a deciduous species, though for such specimen trees it is better to protect the bark with a rag round the stem.

In shelter belts put down on ploughed land it may be necessary to stake each small tree, but with notch planting on ordinary ground, or with pit planting, the firming should be sufficient if the tree is placed against the leeward and solid side of the cut.

Blanking up Failures

When a shrub or specimen tree dies out a year or so after planting no great harm is done if it can be replaced by a duplicate or by some other species, but in a hedge or shelter belt the failure of one plant or tree may be followed by an unsightly gap unless a replacement is made. This should be done in the season after the first planting and a tree or rooted cutting of larger size than the original should be used to compensate for the slower growth in its first year and so preserve the regularity of the belt or hedge. In multiple shelter belts the lines should be checked over in the autumn after planting, and dying and dead plants replaced in the next planting season.

BUDDING OF FRUIT TREES

The budding of pip and stone fruit trees is universally adopted as the best and most economical method of raising young trees and reworking old trees of stone fruit species. Bulletin 81, available *free* from offices of the Department of Agriculture, goes thoroughly into the whole process of budding, and contains valuable information for both the commercial and home orchardist.

PESTS AND DISEASES OF HOME ORCHARDS

SYMPTOMS	INSECT PESTS	HOSTS
Tiny black or grey circular scales, mainly on twigs and limbs. On fruit the scales cause reddish areas with the little scales in the centres.	San Jose scale	Pip and stone fruits
Elongated, pear-shaped, slightly-curved scales on limbs, twigs, and fruit.	Mussel scale	Pip and stone fruits
Twigs and limbs carrying black or brownish-black scales about ⅛in. long. Characterised by raised "H" marking. Usually leaves of infested trees are blackened by sooty mould fungus.	Olive scale	Citrus, pip, and stone fruits
Tiny, circular, reddish-brown scales on limbs, twigs, leaves, and fruit. Very often unnoticed until trees are heavily infested.	Red scale	Citrus fruits
Circular, black, flat scale with a central raised boss of light-brown or grey.	Circular black scale	Citrus fruits
Brown to reddish-brown scale about ⅛in. long, highly convex and of a shining smoothness.	Hemispherical scale	Citrus fruits
Twigs with large, tent-shaped, white or whitish-pink hard scales. Appearance like blobs of candle-grease. The young are small and star shaped.	Hard wax scale	Citrus fruits
Twigs with large, tent-shaped, white, soft scales covered with very soft, white, waxy substance. Young are small and star shaped.	Soft wax scale	Citrus fruits
Oval, soft-bodied, reddish-brown scale with pure white, corrugated ovisac.	Cottony-cushion scale	Pears and citrus fruits
Clusters of white, woolly insects causing swellings on limbs and twigs.	Woolly aphis	Pip fruits
Young developing foliage in spring distorted and curled up. Clusters of tiny, green or brown-black insects.	Green or black aphis	Stone fruits
Foliage turning light-brownish and minute reddish mites on undersides of leaves. In winter a reddish appearance is given to parts of limbs and laterals by the presence of innumerable tiny, round, red eggs of the mites.	Red mite	Pip and stone fruits. A different species of red mite appears on citrus trees
Soft, oval, white insects, mealy in appearance, and ornamented with white filaments.	Mealy bug	Pears and citrus fruits
Silvery appearance of leaves.	Thrips	Citrus fruits
Tunnels bored into fruits.	Codling moth	Apples and pears
Leaves folded up and stuck together or to fruits by fine silken webbing. Surface of fruits chewed under cover of leaves which have been stuck down by the caterpillar.	Leaf roller caterpillar	Different species attack pip fruits, stone fruits, and citrus
Pieces eaten out of young developing fruits between October and December; also small holes in leaves.	Bronze beetle	Pip and stone fruits
Foliage stripped, especially at tips of leaders and branches, or large holes eaten in the leaves.	Brown beetle	Stone and pip fruits
Upper surface of the foliage eaten by small, black, slimy, slug-like grubs swollen at one end.	Pear and cherry slug	Pears and stone fruits

SYMPTOMS	DISEASES	HOSTS
Numerous velvety, black areas on leaves and fruit which gradually extend in area.	Black spot	Different species on apples and pears
Velvety, black, sunken areas on fruits; on leaves purplish spots with white centres.	Fabraea scald	Quince
Weak, unhealthy twigs with deformed tips and deformed flowers, both of which have the appearance of being dusted with flour.	Powdery mildew	Apples and tree tomatoes
Blossoms die and turn brown but may remain adhering to twigs. Light laterals die back, showing light-brown cankered areas. Fruits develop soft, brown rots.	Brown rot	Stone fruit
Three or four weeks after blossoming fruits become greatly enlarged, misshapen, and hollow.	Bladder plum	Plums
Leaves throughout the tree, but especially at the top, show distorted red areas, which gradually increase until the whole leaf has become swollen and much distorted.	Leaf curl	Peaches and nectarines
Leaves become extremely perforated.	Shot hole	Stone fruits
Small, bright yellow areas on the undersides of leaves.	Leaf rust	Stone fruits
Leaves develop dead, brown areas, which increase and cause leaf fall. Small greyish-brown spots on fruit which rapidly increase until the whole of the fruit becomes pallid, grey, and somewhat soft and spongy to the touch.	Citrus brown rot	Lemons and grapefruit
Leaves distorted and with raised pinnacles. Fruit distorted with yellow or light brown warts.	Verrucosis	Lemons and grapefruit
Tips of shoots die. Irregular dead spots on leaves. Brown depressed spots on fruit.	Wither tip	Citrus fruits
Pallid, grey, slightly-polished areas on fruit, which frequently become cracked.	Grey scab	Citrus fruits
Sudden wilting and death of shoots and fruit suddenly wilt and die. Brownish, sunken spots on the fruit.	Brown spot	Passion fruit
Oily spots on green and purple fruits, turning at a later stage to water-soaked areas.	Grease spot	Passion fruit
Death of canes.	Cane wilt	Raspberries
Purplish spots on leaves, which have a shot hole effect. On canes, greyish-white lesions with purplish edges.	Cane spot	Raspberries
On leaves, purplish spots with ash-grey centres.	Leaf spot	Strawberries
Numerous, small, angular, brownish spots on leaves. Leaves wither and fall.	Leaf spot	Currants and gooseberries
Tips of young shoots, leaves, and berries become coated with white, mealy covering which turns brown by autumn.	American gooseberry mildew	Gooseberries
Silvering of the leaves, which are frequently smaller than normal and have slightly curled edges. It usually shows on one or two branches at first, later spreading throughout tree.	Silver leaf	Pip and stone fruits

HEADING PHOTOGRAPH

A knapsack spray outfit such as this is satisfactory for spraying small fruits and low trees. (Photograph by Sparrow Industrial Pictures Ltd.).

Control of Pests and Diseases in the Home Orchard

ONE of the most important items in the successful management of a home orchard is disease control, but seldom is it efficiently carried out, and much of the fruit produced in home orchards is unfit for use because of disease and insect attack. Having expended considerable effort in the pruning, cultivation, and general maintenace of an orchard, it is folly to allow the work to be nullified by failure to exercise efficient disease control.

FRUIT trees in general are subject to the attacks of many diseases, which may be insect, fungous, bacterial, virus, physiological, or deficiency troubles. This article will not deal with all those types of disease, but will outline control measures for insect and fungous groups which can be controlled by spraying.

Insect Pests

Insect pests may be broadly divided into two large classes, the chewing insects and the sucking insects.

In the first class are those which feed by chewing or tearing out pieces of tissue from the host plant. They include such insects as codling moth, leaf roller caterpillar, bronze beetle, brown beetle, pear slug, and raspberry bud moth.

The sucking class may be subdivided into two sections: Those insects such as the aphides and numerous scale insects, which feed by piercing the tissues of the plant with their specialised mouth parts and sucking up the

This is the concluding article of a series by R. G. Hamilton, Horticultural Superintendent, Auckland. The first, dealing with the establishment of a home orchard, appeared in the June issue and the second, covering general aspects of maintenance, last month.

TREATMENT FOR ORCHARD PESTS AND DISEASES

Apples

TIME OF APPLICATION	TREATMENT	PEST OR DISEASE
July-August. Need not be applied if scales, aphis, or mite eggs are not present	Winter oil 1½ pints	Scale insects, woolly aphis, red mite eggs
Early green tip	Bordeaux mixture: Bluestone 6½oz., hydrated lime 5oz.	Black spot, powdery mildew
Open cluster to pink	Lime sulphur ⅓ pint	Black spot, powdery mildew
Petal fall	Lime sulphur ¼ pint, lead arsenate powder 1¼oz., hydrated lime 3oz.	Black spot, powdery mildew, codling moth
Two weeks after petal fall; repeat every 18 to 21 days until end of February	As for petal fall spray	Black spot, powdery mildew, codling moth, bronze beetle, leaf roller caterpillar
When pests appear, about December-January	Summer oil ⅓ pint	Red mite, scale insects, woolly aphis

Pears

TIME OF APPLICATION	TREATMENT	PEST OR DISEASE
July-August; need not be applied if scales or mite eggs are not present	Winter oil 1½ pints	Scale insects, red mite eggs
Early green tip	Bordeaux mixture: Bluestone 6½oz., hydrated lime 5oz.	Black spot
Open cluster to pink	Bordeaux mixture: Bluestone 1¼oz., hydrated lime 2½oz.	Black spot
Petal fall	Bordeaux mixture as for the previous spray, plus lead arsenate powder 1¼oz.	Black spot, codling moth
Two weeks after petal fall; repeat every 21 days until end of February	As for petal fall spray	Black spot, codling moth, leaf roller caterpillar, pear slug
When pests appear	Summer oil ⅓ pint	Red mite, scale insects

The programme recommended for apples may be substituted for that for pears, especially on tender varieties susceptible to russet.

Stone Fruits

TIME OF APPLICATION	TREATMENT	PEST OR DISEASE
June-July. Need not be applied if scales or mite eggs not present	Winter oil 1½ pints	Scale insects, red mite, green aphis
Blossom-bud movement (usually early August for most varieties). It is important to apply this spray at the right stage for control of leaf curl	Bordeaux mixture: Bluestone 6½oz., hydrated lime 5oz.	Leaf curl, shot hole, bladder plum
10-14 days later	Bordeaux mixture: Bluestone 4oz., hydrated lime 5oz.	As this spray is mainly for leaf curl, it may be omitted if the disease is not troublesome

Stone Fruits (continued)

TIME OF APPLICATION	TREATMENT	PEST OR DISEASE
Late pink	Lime sulphur ⅓ pint	Brown rot
Petal fall; repeat every three to four weeks until two weeks before picking	Lime sulphur ¼ pint	Brown rot, shot hole, leaf rust

For apricots substitute colloidal sulphur, 2oz., for the lime sulphur sprays.

For the control of leaf roller caterpillar and pear slug on plums and cherries (about January-February) add ¾oz. of basic lead arsenate to the sprays due about that time.

At the first appearance of black or green aphis add nicotine sulphate, 4/5 fluid ounce, to the next spray and repeat the application of nicotine sulphate 14 days later.

Citrus Fruits

TIME OF APPLICATION	TREATMENT	PEST OR DISEASE
For lemons only before the blossoming of the main crop in October	Bordeaux mixture: Bluestone 4oz., hydrated lime 5oz.	Verrucosis, melanose, grey scab, wither tip
Petal fall of main crop (November)	Bordeaux mixture as above	Verrucosis, melanose, grey scab, wither tip
Early January, but not for lemons	Lead arsenate powder 1oz.	Leaf roller caterpillar
Mid-February	* Summer oil 1 pint, nicotine sulphate 4/5 fluid ounce (5 teaspoons)	Scale insects, black aphis
End of April	Summer oil 1 pint	White wax scales
May-June	Bordeaux mixture: Bluestone 4oz., hydrated lime 5oz.	Verrucosis, wither tip, brown rot

* Include nicotine sulphate in later sprays if aphis is still present.

Berry Fruits (other than Strawberries)

TIME OF APPLICATION	TREATMENT	PEST OR DISEASE
June-July. Need not be applied if scales are not present	Winter oil 1½ pints	Scale insects
Green tip (about September)	Bordeaux mixture: Bluestone 6½oz., hydrated lime 5oz. For raspberries and loganberries add lead arsenate powder 1¼oz.	Leaf spot, cane wilt, bud moth
November and after the fruit has been picked	Bordeaux mixture: Bluestone 4oz., hydrated lime 5oz. For raspberries and loganberries add lead arsenate powder 1¼oz.	Leaf spot, cane wilt, bud moth

Tree Tomatoes

For control of mildew apply lime sulphur (¼ pint to 4 gallons of water) at monthly intervals from November to February.

Strawberries

For control of leaf spot apply Bordeaux mixture (bluestone 4oz., hydrated lime 5oz.) in August and repeat a month later. If red mite is present the second Bordeaux spray may be replaced by lime sulphur (¼ pint to 4 gallons of water).

Passion Fruit

For control of brown spot apply Bordeaux mixture (bluestone 4oz., hydrated lime 5oz., water 4 gallons) in September and October.

For control of grease spot in late crops apply Bordeaux mixture at the same strength at monthly intervals from April to June.

sap; and those, such as thrips and red mite, which rasp the surface tissue and suck up the exuding sap.

Sprays for the control of insects are termed insecticides, and the correct insecticide to use depends on the way in which the pest feeds. For chewing insects a stomach poison, such as arsenate of lead, is applied, and for sucking insects a contact spray, such as nicotine sulphate or a spraying oil. For summer application a more highly-refined oil is necessary than for winter application.

Fungous Diseases

The fungous group includes such diseases as black spot, powdery mildew, and ripe spot of apples; black spot of pears; brown rot, bladder plum, and shot hole of stone fruit; brown rot and verrucosis of citrus fruits; brown spot of passion fruit; cane wilt and cane spot of raspberries; American mildew of gooseberries; and leaf spot of currants and strawberries.

Sprays for the control of fungous diseases are termed fungicides. The most efficient are the copper compounds, of which Bordeaux mixture is the most commonly used. As Bordeaux sprays are likely to russet apple and pear fruits if applied in the summer, the sulphur sprays—lime sulphur and colloidal sulphur—are usually substituted then.

As both insect and fungus attack may occur at the same time, it is often necessary to apply both an insecticide and a fungicide. Certain insecticides and fungicides may be combined in one spray and are generally referred to as combination sprays.

Symptoms of Infection

A brief description of the main pests and diseases likely to be encountered in the home orchard appears on page 140.

Unfortunately there is no known control for silver leaf disease other than removal of affected limbs, or the whole tree when infection is general. When the disease is confined to one or two limbs they should be removed by cutting them well below evidence of infection and painting the cut with a bituminous paint. The best time for the removal of infected limbs is during the early summer, as cut surfaces heal more readily at that time.

Satisfactory disease control cannot be secured by faulty application or inadequate spray coverage. For the spray to function efficiently all parts of the tree must be covered thoroughly with the preparation. Most if not all of the failures to secure satisfactory pest and disease control, even when the correct sprays are applied, may be attributed to inadequate spray coverage because of faulty application. One hundred per cent. coverage is only just enough.

Much of the purpose of spray application is the prevention rather than the cure of disease, and to achieve that it is necessary not only to use the correct sprays at the right time but also to keep fruit and foliage fully covered with the appropriate spray while any particular pest or disease is active. During the growing season the foliage is increasing in extent and the fruit in size, so spray application must be sufficiently frequent to protect the new areas as they develop.

The cause of much poor spray coverage lies in the inadequacy of the spraying equipment. Though the knapsack outfit illustrated in the heading may prove satisfactory for small fruits and low trees, it seldom proves adequate for larger trees. A reliable make of bucket pump fitted with 10 or 12ft. of strong ¼in. hose and a 4 or 5ft lance with disc nozzle will prove satisfactory for most home orchards.

Spraying Programmes

The spraying programmes on the opposite page will be found satisfactory for most conditions, but the quantities given should be closely adhered to, as any variation may result in poor control or damage to the fruit and foliage. All quantities given are for the preparation of four gallons of spray.

Preparation of Sprays

Bordeaux Mixture (to make 4 gallons).—Powdered bluestone may be dissolved readily in 2 pints of warm water in an earthenware or wooden vessel. Bluestone crystals may be tied in sacking and suspended just touching the water in a suitable vessel; do not immerse the sacking wholly in water or the bluestone will take much longer to dissolve. Mix the hydrated lime to a thin paste with 2 pints of water and pour it into 3½ gallons of water in the spray container; then add the bluestone solution. Mix thoroughly and apply as soon as possible. Containers for spraying should be of copper, brass, wood, or earthenware, as bluestone will rapidly corrode iron. If a kerosene tin must be used its useful life will be prolonged if it is thoroughly wiped over with a heavy oil before filling it with spray.

Oil Spray.—Pour the required quantity of oil into a clean container and slowly add an equal amount of cold water while stirring vigorously. If the water is hard, add a small amount of washing soda. Continue stirring until an emulsion has been formed and no free oil is present. Then add it to the water in the spray container.

Nicotine Sulphate.—When used alone nicotine sulphate should have an activator added, such as soft soap (2oz. to 4 gallons) or hydrated lime (4oz. to 4 gallons). Nicotine sulphate may be used with lead arsenate if hydrated lime and not soft soap is used as an activator.

Precautions

The spray pump and all containers should be thoroughly washed out with clean water after use.

The control of disease can be greatly assisted by the destruction of diseased fruit, which should be collected and not left to decay on the ground. Prunings should be picked up and burnt.

Though much pleasure may be derived from a well-kept orchard, successful management is not the result of attention to any one phase of the work but the culmination of adequate attention to all phases. Beware of planting more trees than can be tended properly.

For further information about more local problems the local Orchard Instructor of the Department of Agriculture may be approached.

Substitutes for Jute

THE whole of the next South African wool clip will be packed in 800,000 bales made from an interwoven combination of cotton and paper produced in the Union, according to a report in the International Wool Secretariat's "Wool Digest." Sample packs recently put through extensive packing and pressing tests showed that the bales were even more suitable than the usual jute packs because they were non-hairy.

Experiments are also being made in South Africa to determine the suitability of Karakul wool for making bags. It is hoped that these bags can be used 50 times before they deteriorate.

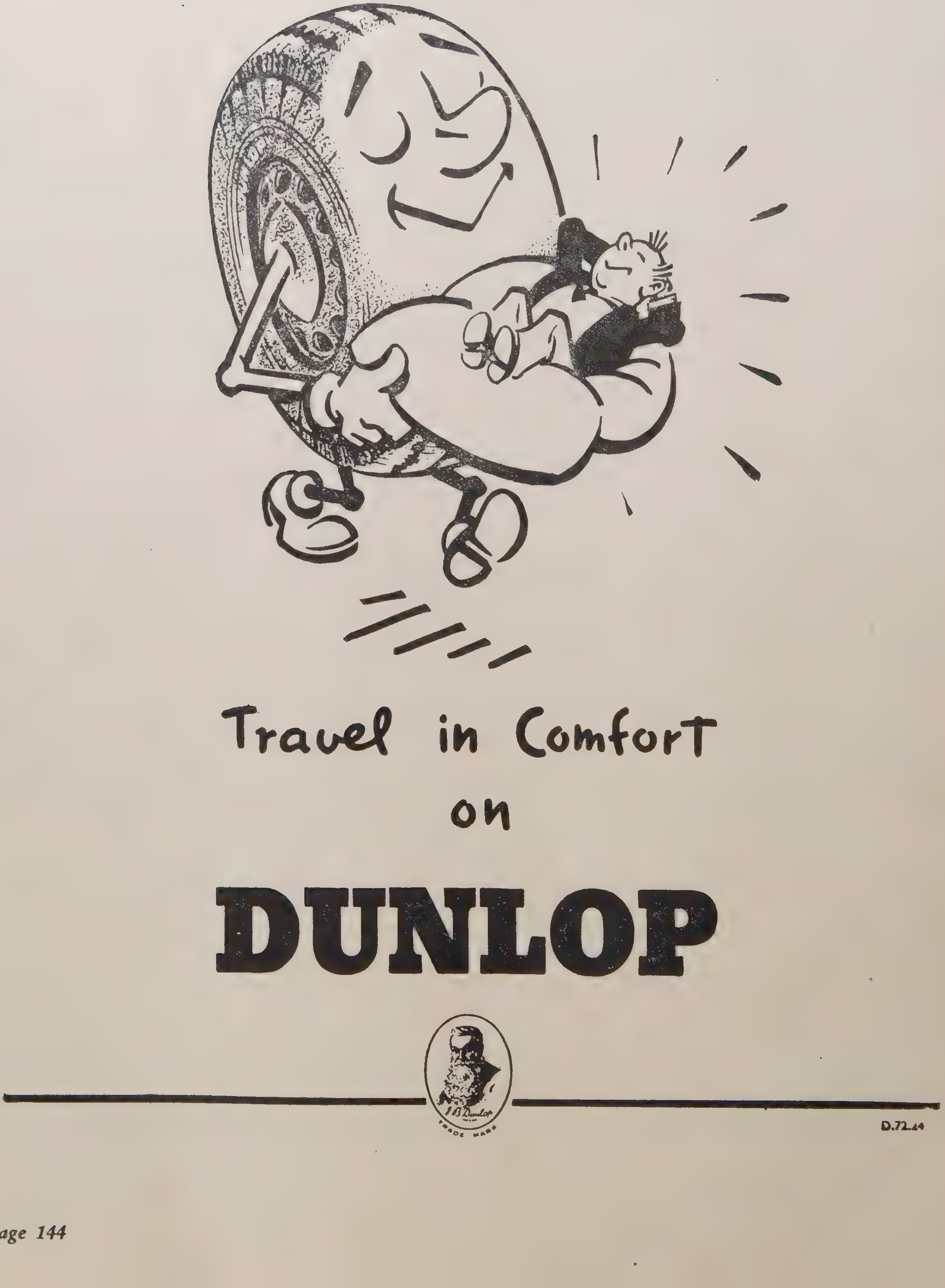
Pig Broadcasts

UNDER the auspices of District Pig Councils broadcasts will be delivered in September as follows:—

Auckland—1YA, on September 17, at 7.15 p.m., "Care of Sow After Weaning and Before Farrowing," by A. F. Barwell, Supervisor, Bay of Plenty District Pig Council.

Wellington—2YA, on September 16, at 7.15 p.m., "Showing Pigs at Agricultural Shows," by I. H. Owtram, Supervisor, Taranaki District Pig Council.

Christchurch—3YA, on September 18, at 7.15 p.m., "Common Pig Diseases," by P. S. McCann, M.R.C.V.S.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Efficient Method of Conserving Surface Run-off Water

By E. H. ARNOLD, *Instructor in Agriculture, Whangarei.*

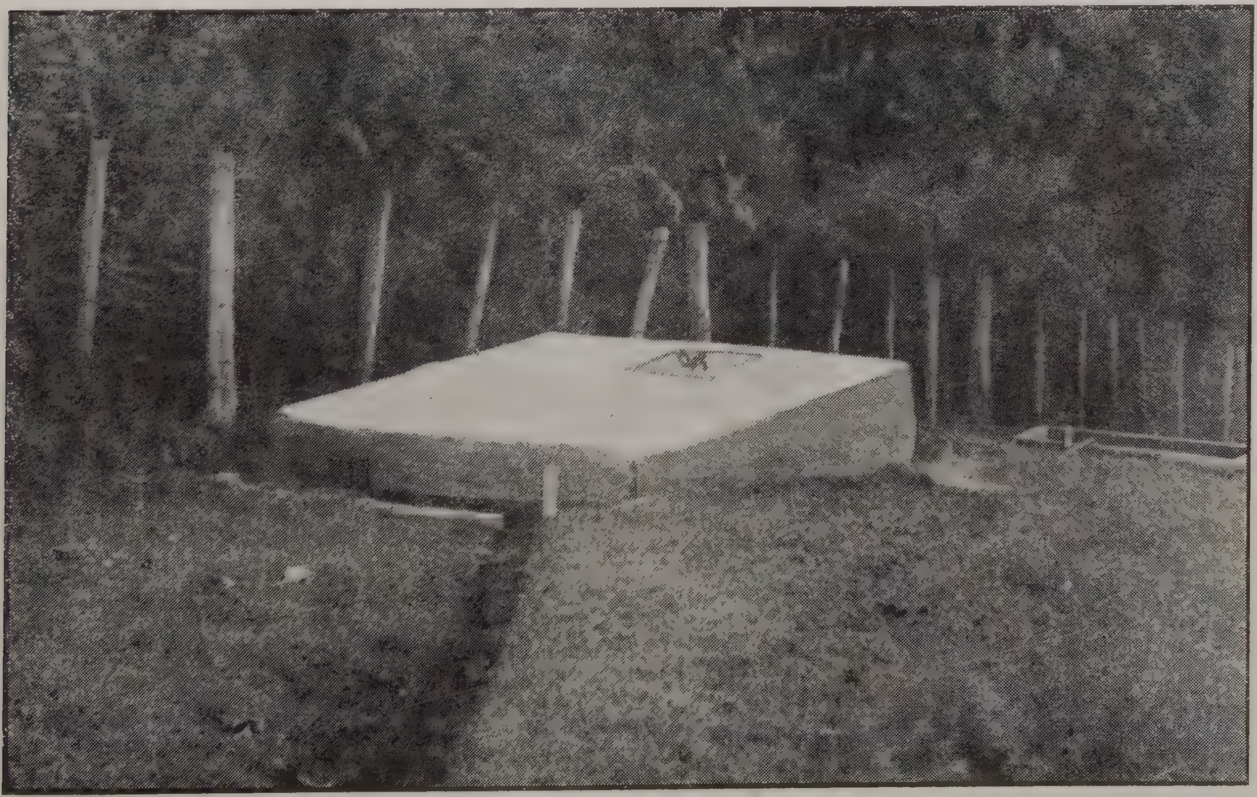
ON many farms, even on undulating country not naturally watered by springs, creeks, wells, or bores, the only feasible method of providing an adequate supply of drinking water for stock is by earthen dams into which surface run-off water collects. Unfortunately many such dams, by their construction and maintenance, provide only impure and contaminated drinking water. Remembering the water cisterns seen in Palestine during the First World War, Mr. A. Briscoe Moore adopted this supply and storage system on the gumland portion of his property at Moengawahine, Pipiwai, North Auckland. That area, like most gumland, is not well watered naturally. The scheme adopted proved eminently suitable for country where the winter rainfall is fair to good and surface run-off is rapid.

THE key to the scheme is a concrete cistern placed to collect the surface water, which is led to it by one or more shallow, grass-covered, open drains. Lengths of tile drain may sometimes prove useful to collect drainage water and lead it to the reservoir. The water runs first into a silt trap, which is 2ft. wide, 1ft. 6in. deep, and extends along the top side of the cistern. Tying in the reinforcing of the silt trap with the reinforcing of the tank will prevent cracking of the concrete where the trap joins the walls of the tank. A screen of wire netting prevents rubbish from entering the silt trap.

The cistern, which is constructed of reinforced concrete 6in. thick, is completely enclosed except for the inlet opening, measuring 9in. by 6in. The walls and floor inside require plastering to prevent water seepage. The roof is provided with a man-hole, closed with a concrete slab, and has a slight fall back to the silt trap. Low curbs along two sides lead rain water falling on the cistern back to the silt trap. From the storage cistern the water is fed by gravity to a drinking trough fitted with a ball cock.

To supply stock on the smaller paddocks near the homestead area Mr. Briscoe Moore has constructed quite a number of these supply and storage units. Each cistern has outside measurements of 7ft. square, is 6ft. deep, and holds 1100 gallons. If he were to construct more units, he would enlarge them to hold at least 1500 gallons. On other farm properties the size could be increased if a sufficiently-large run-off collection area is available to fill the cistern during the rainy season.

This ingenious scheme provides a reserve of water in a cistern completely enclosed except for the small inlet. With sunlight excluded, the growth of undesirable organisms in the water is inhibited and cool, pure water is available to stock.



Shallow, grass-covered open drains lead the water through a silt trap into the storage cistern. From there it is fed by gravity to the drinking trough below.

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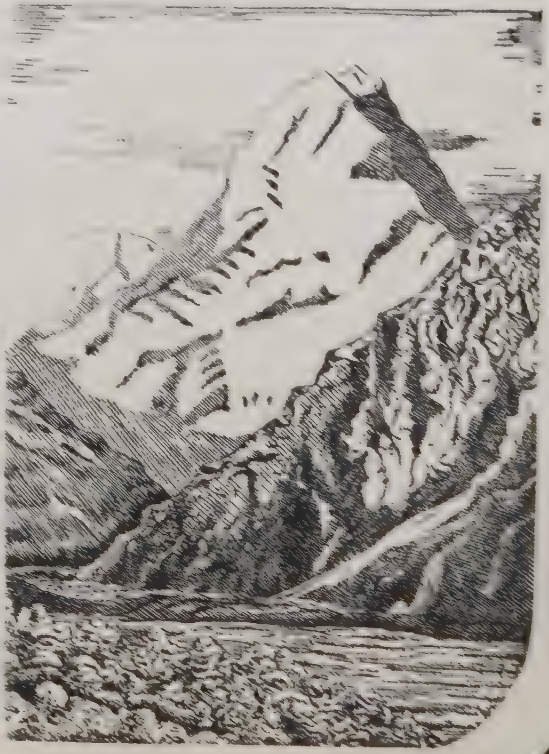

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USE OF POLLEN SUPPLEMENTS IN NEW ZEALAND

To Improve Hive Strength Under Certain Conditions

By T. PALMER-JONES, *Research Officer, Animal Research Station, Wallaceville.*

ADEQUATE supplies of pollen are essential for the production of strong colonies of bees, and pollen shortages are often reflected in marked decreases in the amount of honey produced. There are areas in New Zealand where bountiful supplies of nectar are offset by pollen deficiencies or where climatic conditions hinder the bees in their collection of pollen. The use of a satisfactory pollen supplement in such areas improves colony (hive) strength and increases the honey crop. The following article describes the method of feeding the supplement made from soya bean flour and dried pasteurised yeast.

COMMERCIAL beekeepers realise that adequate supplies of pollen are essential for the production of strong colonies of bees. Pollen supplies almost the entire protein requirements of the bee. It is necessary for the growth of the body, and becomes especially important in the food of larvae. Brood cannot be reared in the absence of pollen. Protein is not only used as food by the larva, but great quantities are stored in its so-called fat-body to be used during the changes to the adult condition. The larva has been shown to contain 11.25 per cent. of protein at the time of sealing. Larval or young bees cannot be fed on honey or sugar syrup alone without harm, but adult bees can live on it for long periods without apparent adverse effect. The adult bees can do without protein for some time, as they are fully grown and their bodies contain protein reserves. In the autumn bees store up these reserves in their fat-bodies, where they serve as a source of brood food in the early spring. If a colony is fed solely on honey or sugar syrup, these reserves are depleted. Worker bees doubtless modify protein material before preparation of larval food by secretion, but it is unknown how much they use for repair of their own bodies during adult life.

It has been estimated that a strong colony requires 40 to 50lb. or more of pollen to maintain optimum brood rearing for a year. American workers have shown that for maximum efficiency hives should have ample pollen reserves.

FARM NEWS BROADCASTS

Farm news sessions are broadcast over main national stations every Thursday at 9.20 p.m.

For many years beekeepers in other countries have attempted to supply a satisfactory substitute to bees in times of pollen shortage. Finely-ground pea, rye, corn, or oatmeal flours and other substances have been supplied in convenient places to bees, which in times of pollen dearth will readily carry them into the hives. It is only in recent times that Haydak, an American, scientifically compared the worth of these substances with natural pollen. The method used was to feed the substitutes to young bees which had never eaten pollen. They were used to form small colonies into each of which a young fertile queen was introduced. Records were kept of the growth of these bees (the changes in weight and protein content), mortality, and the quality and quantity of the reared brood. Among other substances tested were dried yeast, dry skim-milk, whole eggs, whole wheat, oats, rye, corn, and pea flours, commercial casein, and soya bean flour.

Many of the substances tested were unsuitable, but it was discovered that soya bean flour, mixed with dried skim-milk in the proportion of four parts to one by weight, was a satisfactory pollen substitute for bees. Results obtained with this mixture were comparable with those secured using natural pollen. Soya bean flour of a low fat content (0.5 to 7 per cent.), produced by the expeller method, gives the most satisfactory results. The flour should contain about 50 per cent. of protein. In 1945 Haydak advised feeding nine parts by weight soya bean flour and one part dried yeast if feeding was necessary for long periods. Medicinal yeast of the type used for human consumption was recommended. Such substitutes were mixed with sugar syrup to a porridge-like consistency, and fed inside the hives, being pressed down between the combs over the brood nest.

Although the soya bean flour and dried yeast mixture has been claimed to approach natural pollen in results, such mixtures should not be regarded as a complete substitute for natural pollen, the term "pollen supplement" being preferable to "pollen substitute."

The feeding of pollen supplements has become a commonplace procedure in many parts of America, the expense and labour involved being considered economically justified by results.

The use of pollen supplements in New Zealand had not been developed, as it was generally considered that bees could obtain natural pollen in sufficient quantities throughout the year. Central Otago and Otira are exceptions, and beekeepers in those districts have realised that the unusual local climatic conditions cause a pollen shortage in the spring. In parts of Central Otago the severe winters prevent the growth of many of the spring plants which elsewhere provide an early source of pollen. Although such plants are present in sufficient numbers at Otira, rain and cold in the spring prevent bees flying enough to benefit. There is reason to suspect that these two factors, acting separately or in combination, may cause a spring pollen shortage in other parts of New Zealand.

Symptoms of Pollen Deficiency

In pollen-deficient areas colonies rapidly use up pollen reserves in the spring, and brood rearing then becomes restricted, resulting in backward hives with insufficient bees to collect a large honey crop.

Apart from causing a reduction in hive strength, lack of pollen may affect the well-being of a colony in a different fashion. Careful observations made by Mr. W. A. Coombes, Otira, have shown that pollen-deficient hives may discard their queens. The occasions on which this occurred were always immediately after a period of bad spring weather had precipitated a pollen shortage at Otira. The queens, which were first-season ones, were laying at the time they were discarded. The phenomenon invariably occurred in hives destitute of pollen; hives with pollen reserves retained their queens. On one occasion eighteen hives of nineteen under observation discarded their queens. The sole hive which retained its queen had a store of pollen, while the others were bare.

USE OF POLLEN SUPPLEMENTS . . .

Attempted supersedure of vigorous queens, resulting in a rapid dwindling of hive strength, and even complete loss, may thus be caused by pollen deficiency. Hives broken down in the spring to form nuclei may suffer from pollen deficiency if unprovided with sufficient combs of pollen. Unseasonable weather would increase the likelihood of this occurrence. Cases have been reported of such nuclei balling their queens or rejecting them.

Pollen Supplement Trials

Pollen supplement trials were commenced with the following aims:—

1. It was first necessary to find to what extent pollen supplements would benefit apiaries under New Zealand conditions in regions suspected of being pollen deficient.
2. Assuming the supplements successful, the factors of cost and time and labour involved in feeding them would require assessing to determine if their use was economic.

In 1944 preliminary trials in Central Otago proved that for local conditions a dried yeast and soya bean flour mixture was superior to mixtures of soya bean flour and dried skim-milk, soya bean flour and dried blood, soya bean flour, dried skim-milk, and dried yeast, and dried blood, dried yeast, and dried skim-milk. The mixture of nine parts soya bean flour plus one part dried pasteurised yeast by weight not only gave better results than the others, but its keeping qualities were much superior.

Method of Conducting Trials

A group of hives of equal strength was chosen in an apiary suspected of suffering from a seasonal pollen deficiency. Pollen-containing combs, if present in these hives, were evenly distributed throughout the group. Weighed amounts of the supplement, mixed in sugar syrup, were then fed in the late winter or early spring to half the hives, the remainder being used as controls. General condition of individual hives, total weight of supplement fed in 1lb. lots, weather, area of brood, and other relevant details were noted on special record sheets. The "area of brood" was measured by a convenient artificial unit taken as a comb of brood, with both sides completely filled with brood, every stage of development from eggs to capped brood being included. Although this system of measurement had limitations, unsuitable weather conditions for frequent opening of hives prevented the adoption of a more accurate one. The area of brood was estimated at the start of the experiment and on two later occasions, first when enough natural pollen was coming in to render the bees independent of the supplement, and again some weeks later.

Result of Pollen Supplement Trials

The dried pasteurised yeast and soya bean flour supplement was used in the following trials.

In 1945 a preliminary experiment was conducted at Otira, the supplement being fed to 15 hives with a similar number of controls. When the experiment concluded on December 12, 1945, the area of brood, measured as described, was 4.56 full combs for the hives fed supplement and 2.41 for the controls. Approximately 5lb. of supplement was fed each hive.

In 1946 an experiment at Otira showed the value of the supplement (see table I below).

This table shows that the average yield of honey for hives fed the supplement exceeded that of the controls by 57lb. The weight of supplement fed was approximately 10lb. a hive at a cost of 3/3d. The use of the supplement was therefore amply justified on an economic basis, an expenditure of 3/3d. in cash plus the small amount of labour involved resulting in an extra 57lb. of honey.

The area of brood produced by the hives fed supplement was comparable with that of those fed natural pollen and was more than twice that of the controls. Three control hives were lost during the course of the experiment through lack of pollen, reducing controls from ten to seven. In 1945 and 1946 hives fed the supplement entered the summer with much greater strength than the controls.

It will be noted that hives fed natural pollen in combs gave a higher average yield of honey than those fed supplement. These hives were only three in number and their average yield is probably not very representative. This is borne out by the figures for brood area at the end of the experiment, which are almost the same for both groups.

Experiments with the supplement in 1945 at Aurora (South Taranaki) and in the Paparangi area showed that it materially aided the building up of colonies in the early spring, particularly in colder areas where the bees had very few flying hours each day at that time of the year.

In an experiment conducted at Kokonga, Central Otago, in 1946 the difference between the control hives and those fed the supplement was outstanding as the season advanced. Hives fed the supplement were the only ones fit to divide at the beginning of December.

Pollen supplement trials were conducted near Gore, 400 hives being fed the supplement during the 1946-1947 season. Unusually severe weather conditions in the late spring and early summer caused these hives to use up all reserves of natural pollen. The apiarist conducting the trials reported that what honey crop was gathered by the hives could be credited to the effect of the pollen supplement. Two apiaries not fed the supplement which were situated among those fed collapsed entirely for lack of pollen.

Where to Use Supplement

Trials have shown that the supplement may be fed with great advantage to hives suffering from a spring pollen deficiency in parts of Central Otago and at Otira. Although acute symptoms of pollen shortage may be lacking, it appears probable that in many districts the feeding of a supplement would result in a larger field force of bees and a greater honey crop. Benefit may be derived from the supplement in districts where the spring is often cold, as in South Taranaki. In many areas the supplement should be of assistance when raising nuclei in the spring and autumn.

It must be stressed that results obtained from the supplement should be considered in relation to its cost and the labour involved in mixing and feeding it. Although the value of the supplement has been proved in Central Otago, Otira, South Taranaki, and the Paparangi area, its use in many parts of New Zealand is unlikely to be an economic proposition.

Beekeepers with apiaries in districts suspected of providing insufficient pollen, particularly in the spring, should give the supplement a trial on a small scale, with control hives, before deciding to use it in large quantities.

TABLE I—RESULTS OBTAINED AT OTIRA FROM A POLLEN SUPPLEMENT

Allocation of Hives in experiment.	Average area of brood per hive at start of experiment, 8/9/46.	Average area of brood per hive at end of experiment, 17/12/46.	Average yield of honey per hive during season.
	combs	combs	lb.
Hives fed supplement (10)	1.2	6.15	179
Control hives (7)	2	3	122
Hives fed natural pollen in combs (3)	2.25	6.25	266

Details of the methods employed in using the supplement are as follows:—

Mixing and Storing Supplement

The supplement recommended is one consisting of nine parts by weight of soya bean flour thoroughly mixed with one part by weight of dried pasteurised yeast. The soya bean flour should have a fat content of from 0.5 to 7 per cent., and the yeast should be of the dried, pasteurised, medicinal type.

It is essential to obtain thorough mixing of the constituents in a finely-divided form. Soya bean flour consists of fine grains and will mix well, but the yeast is usually supplied in flakes, which must be passed through a grinder before mixing. At the Wallaceville Research Station it was found that a grinder with mesh openings of 1/32in. was satisfactory.

The most convenient method of preparing large quantities of the dry supplement is with a concrete mixer, which will effect thorough mixing in a few minutes. An alternative method is to mix the constituents thoroughly by turning them over and over with a spade on a flat concrete floor.

Exposure of the supplement to damp air after mixing is liable to cause spoilage by moulds and weevils, and it should be kept in air-tight tins until required for feeding to the hives. Thirty-five-pound grease tins with 6in. lever lids are ideal for storage, and the supplement has been kept in these at Wallaceville for over a year without any deterioration. Ordinary 10lb. honey tins are also perfectly satisfactory.

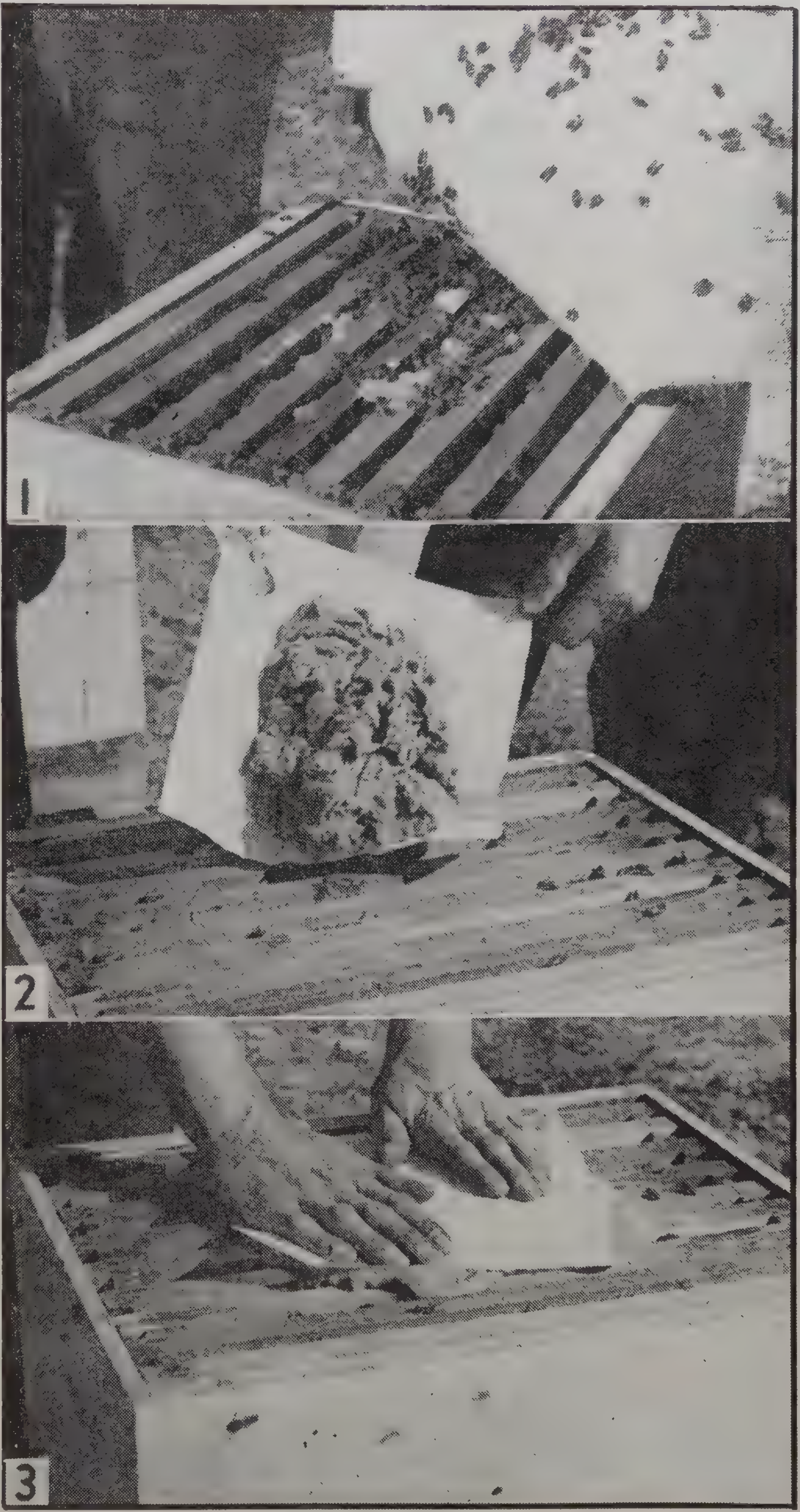
Feeding the Supplement

The supplement is mixed with sugar syrup for feeding to the hives, thorough stirring and breaking up of lumps being necessary to bring the finished product to the required consistency of thick porridge.

The sugar syrup is prepared by dissolving two parts by volume of sugar in one part by volume of hot water. One and a-half pints of this sugar syrup are mixed with each pound of the supplement. It is important to use these proportions in mixing the supplement, as otherwise it may be either too sloppy or too dry for satisfactory use. Honey can be used in place of sugar for feeding the supplement.

The supplement is usually fed in cakes of about 1lb. per hive. The cakes are spread out over the cluster and pressed down between the top bars of the frames. It is advisable to place a sheet of grease paper over the supplement to prevent it drying out. This may be omitted if the supplement is being rapidly consumed. A convenient method of feeding the supplement in an apiary is to place the correct quantity for each hive on a square of grease paper, which is then

FEEDING THE POLLEN SUPPLEMENT



1. Hive mat removed ready for feeding supplement. 2. Supplement on square of grease paper ready for feeding to bees. 3. Supplement being pressed down between top bars over the cluster.

USE OF POLLEN SUPPLEMENTS . . .

upended over the brood chamber and the supplement pressed down between the frames by pressure applied to the upper surface of the paper (see illustrations).

One pound of the dry supplement gives about 3½lb. of the mixture ready for feeding.

The supplement should not be kept made up with sugar syrup, but should be mixed only as required. It should be fed according to the requirements of the hives, in the late winter or early spring, and feeding should be continued until the bees will not accept it.

The largest quantity of supplement mixed with sugar syrup fed per hive in pollen-deficient areas has been 10lb. in a season. Feeding at fortnightly intervals is satisfactory, but by feeding two or three pounds at a time this period could be extended.

In Central Otago the dry supplement spread out on boards in the apiary has been avidly collected by the bees. However, this method is not recommended for general use, as it depends on fine weather, and weak hives with a small field force of bees would not benefit to any extent.

Both soya bean flour and dried yeast of the right composition for use as pollen supplements are on sale in New Zealand. Details of sources of supply are obtainable from local branches of the National Beekeepers' Association.

Cost of the Supplement

On present-day prices soya bean flour costs 75/- a 100lb. bag and dried pasteurised yeast 45/- a 10lb. tin. Buying on this basis, soya bean flour costs 9d. a lb. and dried yeast 4/6d. a lb., while 1lb. of the dry supplement costs 1/1½d. As 1lb. of the dry supplement becomes 3½lb. when mixed with sugar syrup or honey, the cost of feeding a hive 10lb. of supplement in sugar syrup, which is more than the usual weight required in a season, is about 3/3d. This calculation omits the cost of the honey or sugar used, but as this may be regarded as part of the regular spring feeding, its value may be omitted for practical purposes.

If the supplement is mixed in the dry condition during the winter and stored in tins, the labour involved in feeding it is small, and its use can be worked into the scheme of normal seasonal operations.

American workers have found that when natural pollen is abundant it may be trapped from bees in large amounts and used in pollen-deficient areas. Here it may be fed to hives in cakes containing 25 per cent. or 50 per cent. pollen, the remainder being soya bean flour. The use of such a supplement, involving the use of pollen traps, is much more complicated than the method described in this article. However, work has been carried out on the use of pollen traps in New Zealand and will be published later.

Acknowledgments.

The successful carrying out of the pollen supplement trials was rendered possible by the co-operation of the following apiarists:—Messrs. L. Box, Heriot, Otago; W. A. Coombes, Otira; F. J. Glass, Waikaka, Gore; J. S. Horn, Kokonga, Central Otago; E. J. Kirk, Wanganui; W. J. Lennon, Omakau, Central Otago, and A. Myers, Oturehua, Central Otago.

Spring Sowing of Pastures

By J. D. WRAIGHT, *Fields Instructor, Timaru.*

EACH spring some farmers face the necessity of increasing their areas of new grass by spring sowings, as it is not always possible to sow all pastures in the autumn. Also there are areas of stubble land, fed-off turnips, and rape, which have completed their cropping cycle and are ready to be sown out to pasture in the spring.

WEED growth is bad in the spring, as most arable land after years of cultivation has an immense population of weed seeds, which usually makes its presence felt more in the spring than at any other time of the year. Because of this, general sowings of pastures take place soon after the new year when the spring weeds have reached peak growth. However, in spite of difficulties from weeds, much spring sowing of pasture is done, mainly from expediency, and also because particular attention can be given to the establishment of such plants as white and red clovers.

In a pasture sown with white or red clover in the spring the clover will be at a more fully-grown stage next harvest than if it were sown in early autumn, and this has a decided effect on whether it produces a seed crop. There are, therefore, advantages in spring sowing, the main disadvantage being weed interference.

Summer Shortage

As at any other time of year, a pasture sown without a cover crop will establish best, and the subsequent growth can play a very important part in tiding over the usual shortage period during the summer. Such spring sowings could very well form part of the crop rotation, in that perennial grasses and clovers sown early enough can produce well, and partly at least displace the more pronounced annual species which are often sown, especially for supplementary greenfeed.

Nevertheless, from expediency many spring sowings of grass and clovers are made either with spring-sown cereals such as oats, barley, and linseed, or as an oversowing on autumn- and winter-sown wheat. The main consideration in the choice of a cereal with which to sow the grass is the amount of its "flag" or leaf growth, which will shade or crowd out the young grass and clover seedlings. Oats, particularly the stronger-growing varieties, produce the most "flag," while barley and linseed are not so bad in this respect. In all cases where cereals and grass are to be sown together it is wise to sow on a well-rolled surface, which will prevent too deep a sowing.

Sowing With Wheat

Sowing down red clover on a winter- or autumn-sown wheat crop usually takes place in September when the wheat is rolled and harrowed; an excellent seed-bed is thus provided for clover and grass seed. It is recommended to sow 4 to 5lb. of red clover seed with ½ to ¾ bushel of perennial ryegrass to produce a sward which is clover dominant and suitable for a seeding crop. White clover may be oversown at the rate of 2 to 3lb. per acre with a similar quantity of ryegrass.

Clovers grow especially well when spring sown and this fact can be turned to advantage by sowing them either with cereals and rape crops or by oversowing established cereal crops.

TOBACCO GROWING

Tobacco leaf suitable for manufacturers' requirements can be grown economically in New Zealand, but proper culture, selection of suitable varieties, and proper curing are essential. Bulletin No. 137, "Commercial Tobacco Culture," contains much worthwhile advice for tobacco growers. Write to any office of the Department of Agriculture.

Clearing Gorse Land with Tractor and Giant Discs

By R. P. HILL, *Fields Instructor, Hastings.*

GORSE has taken possession of much New Zealand land which could be put to a useful purpose. On hilly country eradication is difficult, but on flat country the task is easier, though frequently the land is of such low fertility that the expense is not considered worth while. The cost of the customary methods of clearing and cultivating land heavily infested with gorse is usually high; the gorse must either be grubbed by hand or ploughed with a swamp plough, in which case it must be cut and burnt first. An extremely efficient method has been adopted on a property owned by Messrs. Worsnop Bros., at Springhill, Tikokino, Hawke's Bay. Some 400 acres of land which was previously covered in gorse, the majority of it 12ft. high, has now been brought into production, and the implements used were a crawler tractor and a set of giant discs (five a side), with small scallops.

THE land on which this work was carried out is flat, consisting of gravelly sand on a gravel subsoil, and was at one time a river bed. When cleared the soil is capable of growing good crops of turnips, chou moellier, and pasture with subterranean clover dominant.

Heavy Bar on Tractor

On the front of the tractor is fitted a bar capable of taking a heavy strain. When the tractor, with heavily-weighted giant discs attached, is driven over the gorse, the bar forces the standing growth forward and down, the tractor flattens the growth, and the discs flatten it still further and, being set with a heavy cut and having scallops, pull out much of the gorse by the roots. Though the gorse averages 10 to 12ft. high, once over the area is sufficient to lay most of it flat, but in some particularly-thick sections it is sometimes necessary to go over more than once. In that case the machine is always driven in the same direction, so that all branches are left lying in one direction.

When an area has been completed it is left for about six weeks and then burnt. After that there are practically no sticks left on the ground, and the land is disced again twice, which forms a fair seed-bed. The land is then harrowed with a heavy chain harrow. In February Imperial Green Globe turnip seed is drilled in with 2cwt. of serpentine superphosphate an acre. The drills are 14in. apart and, though the ground is fairly rough, breakages are not unduly heavy.

The turnips are grazed by sheep, which also eat off any seedling gorse which may come through. In the spring the land is again disced, the ground being much cleaner, and after being harrowed it is sown in November with chou moellier in 14in. rows, again with serpentine superphosphate. That crop is eaten off during the following winter by heavy concentrations of sheep, which again clean up any gorse seedlings which may have germinated.

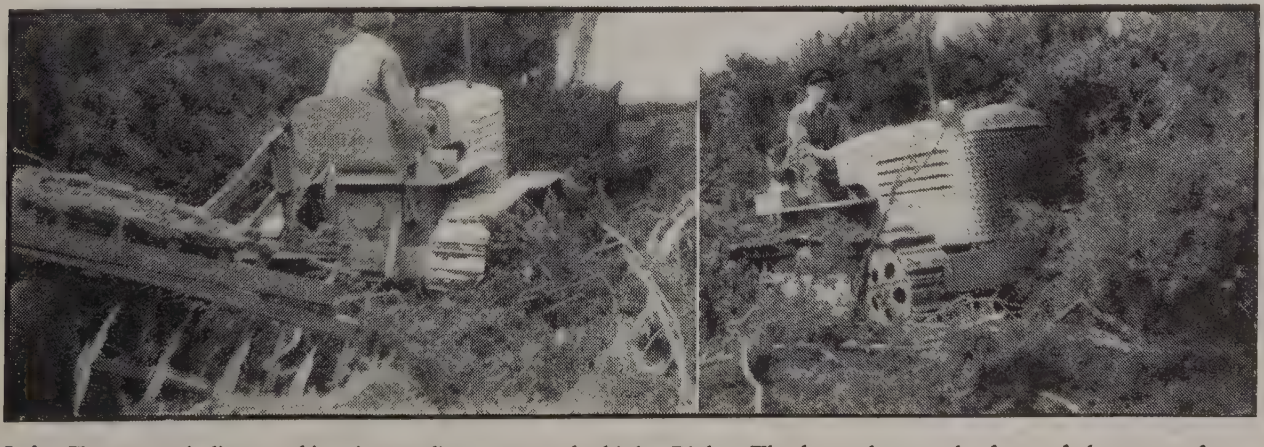
In the next summer the land is again disced, harrowed, and rolled, and in February it is laid down to permanent pasture. The pasture seed is drilled in 7in. rows. The land being light and stony, the owners believe that by drilling the fertiliser with the seed better establishment is obtained and the seed is less likely to be blown by the wind. The following light mixture is sown:

	lb. per acre
Certified perennial ryegrass	16
Cocksfoot	3
Certified white clover	2
Subterranean clover	2
Total	23

Grazing Management

In the first year the grass is grazed with sheep and cattle and becomes well established. Though the grass is showing only in drill lines, care is taken in the late spring not to graze it too hard so that the subterranean clover may seed. By the next year all the ground between drills has been filled up by subterranean clover plants and ryegrass and cocksfoot stooling out.

At the end of three years satisfactory grass paddocks are obtained from an area of what had appeared a hopeless gorse waste, and at a very small expense. The cost of this initial development by discs is no more than that of one deep ploughing, and the crops considerably more than pay for the cultivation. In the first paddock laid down no young gorse appears to be coming away, all seedlings germinating having been eaten out by heavy sheep concentrations at the correct time.



Left—Tractor and discs working in standing gorse 12ft. high. Right—The heavy bar on the front of the tractor forces the gorse forward and down.

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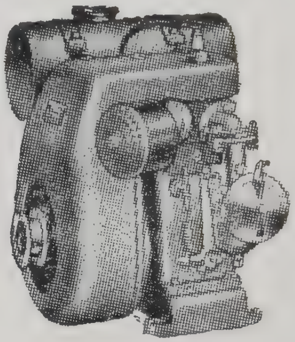

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The Home Garden in September

By A. G. KENNELLY, *Instructor in Vegetable Culture, Christchurch.*

SEPTEMBER is the month when most seed sowing is carried out. In some districts main crops can be put in, and in a few districts even such frost-tender vegetables as dwarf or French beans, pumpkin, and marrow can be sown outside. Under glass the sowing of tomatoes, celery, and cape gooseberries can be made.

LEEKS, brussels sprouts, and cauliflower can be sown during September in the open seed-bed or under glass. Early potatoes will need protection from frost, and seedling lettuce, silver beet, cabbage, and cauliflower can be set out or gaps can be filled in previously-planted crops. The preparation of the ground should be continued, and if broad beans are in danger from heavy winds, they should be supported by brushwood stakes, or strings tied every 5 or 6ft. to stout stakes can be run at a suitable height around the outside of the rows. Liquid manure can be applied to standing crops such as silver beet and spring cabbage; strawberries also will benefit from its application.

Cause of Frost

There are few, if any, completely frost-free districts in New Zealand, and at this time of year the question of frost and the apparent inconsistencies of its behaviour provide a frequent subject for discussion among home gardeners. Though the average home gardener cannot change the site of his garden unless he chooses to make his home elsewhere, an understanding of some of the principles of frost formation and methods of prevention will be useful to him in his garden work.

Frost is caused by loss of heat by radiation (heat flowing from the plant to the colder air about it). As most people know, frost occurs when the temperature drops below 32 degrees F. A "white," or hoar, frost is ice consisting of frozen dew drops and feathery, spinelike ice crystals deposited on exposed surfaces. The deposit of ice is formed from moisture that comes partly from the ground and the air, and in the case of plants, probably partly from the plant itself. The term "black" frost is as a rule used when plants are frozen without the appearance of any deposit on them. It occurs when the temperature falls below freezing point, but is not low enough to cause the moisture to come out in the form of hoar frost. (This is analogous to what in summer is known as dew point, when on a clear evening the air, growing colder and colder, reaches a point where it must give up some of its moisture.)

Cooling of Earth After Sunset

During the day the sun supplies more heat to the earth and to plants than is given off, and by sunset during the warmer part of the year the air has been warmed to a height of several hundred feet. After sunset the earth cools rapidly and becomes colder than the layer of air in contact with it. The earth then cools this layer of air, but as air conducts heat very slowly, atmospheric cooling does not extend to great heights. Thus on a clear, cold night when frost is likely to occur, the air near the ground may be 10 degrees colder than that 10 to 15ft. above and, in fact, the temperature of the air 300ft. above the ground as a rule changes but little during the night. For this reason frost is less likely to occur on a windy night, as the wind stirs up the atmosphere, preventing the cold air settling and mixing the warmer air from higher levels with it. As a means of frost prevention this principle has been applied with varying success overseas in the use of propellers or wind towers, by which it is aimed to mix the warmer air from higher levels with the cold air near the surface. The reason that frost is unlikely to occur on cloudy nights is that clouds check radiation, and as the heat given off does not penetrate them easily, they reflect much of it back to the earth. It is probably because of this that the idea of using smudge fires for frost control originated.

Apart from its heat, which is quite effective, the smudge itself is not now considered by most authorities to be of much use unless it is heavily laden with moisture. Smoke on a still night usually rises vertically and its value as a returning agent for radiation loss is far less than that of a cloud.

Accumulation of Cold Air

As the earth cools after sunset and the air in contact with it becomes colder every object exposed to the sky on a clear night continuously gives off its little quota of heat.

The degree of cold reached by an object is mainly governed by the extent to which the air surrounding it can counteract that loss by its own warmth. Owing to the cooling that takes place as the result of evaporation plant parts such as leaves, which contain high concentrations of moisture, become even a little colder than the air around them. Cool air, being more dense than an equal bulk of less cool air, gradually accumulates until it is impelled by gravity to fall or rather drift to lower levels.

Air flows in a similar manner to water, except that the weight of 1 cubic foot of water is about 1000 times heavier than 1 cubic foot of air, and therefore where water would pour swiftly past, around, or through an obstacle the flow of air, because of its comparative lightness, drifts slowly around or piles up against the obstacle.

In spring this gradual building up of masses of dense cold air results in the collection of chilled air in hollows or low places. These collections of chilled air gradually build up to ever-greater depths, with the very dense air of icy coldness slowly accumulating at the bottom of them. As the night advances the cold air drains off the higher ground and fills up hollows, and where it cannot spread out thinly, as on a wide plain, or escape to a lower level such as the sea, it builds up to damaging depths. The downward flow slows up on gradual slopes and descends as a shallow film on steep hillsides.

Severity of Frost

The severity of a frost will depend on the amount of cold air produced during the night in relation to (a) the amount of high ground (or feed area) in proportion to low ground, and (b) the extent to which the cold air can drain to open spaces or to sea level.

Spring or autumn frosts, unlike winter frosts, do not as a rule build up to very great depths, and gardens on hill areas, even relatively-low hill areas, are unlikely to suffer frost damage as long as they are not so placed that cold air draining from higher levels collects on them.

Land at Sea Level

Land at sea level or sloping to the sea is usually safe from the effects of frost, as the level surface of the water offers an unlimited plane for the cold air to spread out and remain shallow. Water has a good capacity for holding heat, and the sea or great masses of water such as wide rivers or lakes will reduce the danger of frost to land near them, as the water remains well above freezing point and during the night loses so little heat that the cold air flowing on to it from the land is itself warmed by contact.

Other Factors in Frost Formation

Among other factors influencing frost formation is the condition of the

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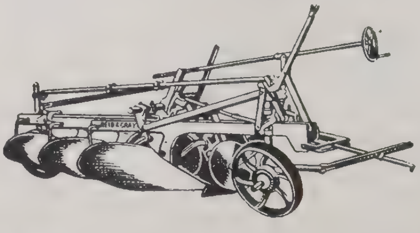

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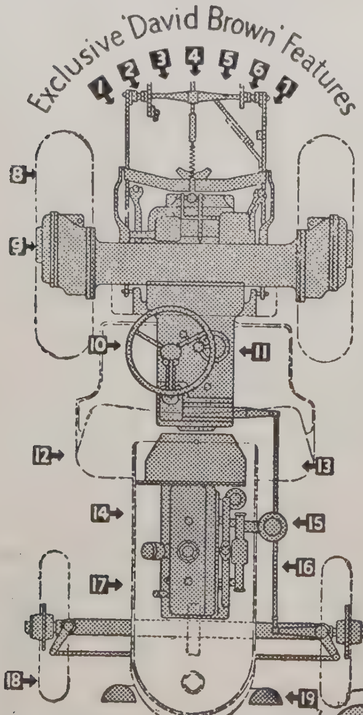

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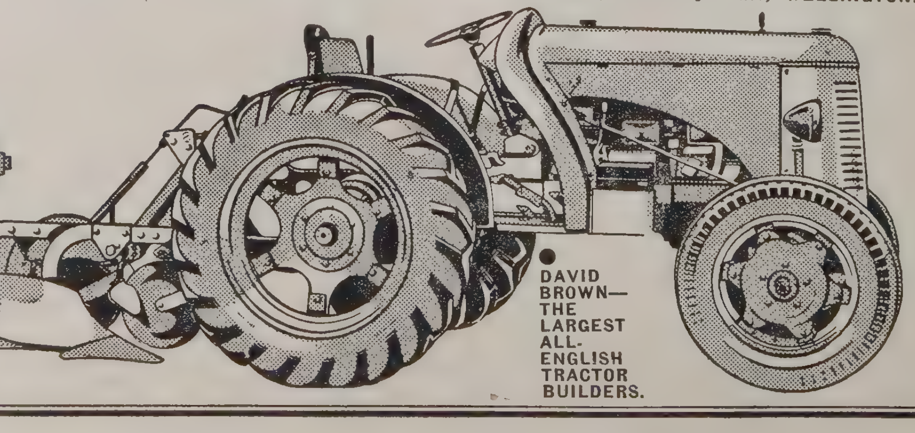

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soil. For example, wet soil is a good conductor of heat and is less liable to frost damage than newly-turned ground, grass, and weeds, which are poor conductors and so tend to increase the severity of the frost. Land contour is very important, as is also the planting of trees and hedges in such a way as to allow cold air to drain away to lower levels rather than to hold it so that it either builds up to damaging depths or is held so long in draining down a specific path that objects on that path are frosted. These factors may sometimes explain the apparent inconsistencies of frost behaviour.

Frost Damage

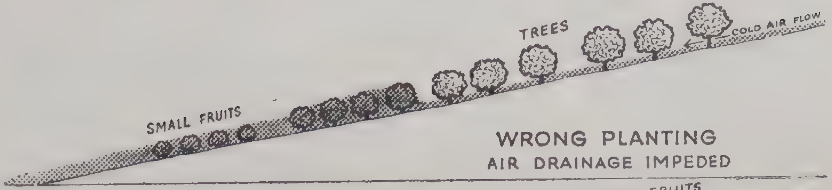
Under frost conditions crystals of ice form in the plant tissue and in frost-tender plants damage the cells to such an extent that they die. Some competent observers have stated that the ice nearly always forms in the intercellular spaces, the water being withdrawn from the cells to form the ice crystals. Whether death is caused by the withdrawal of water from the cells or is merely associated with it does not appear to be certain. In some cases the rapidity of thawing appears to have some influence on the extent of the injury, but whatever are the actual facts of frost damage it is clear that the internal expansion of water as it turns to ice in the tissues must be a disruptive agent.

Methods of Combating Frost

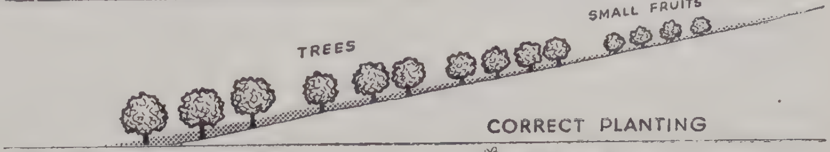
The home gardener can do relatively little to combat frost. For him the methods practised by the commercial producer, such as the heating of the air, the production of smoke or water vapour, the mixing of warm air with the cold, and irrigation, are not practicable. He can, however, use screens or covers, or plant in sheltered situations or in such a way as to minimise the worst effects of frost. He can often make use of the fact that a temperature that may destroy one plant often causes little injury to its neighbour, for varieties or even individual plants differ greatly in ability to withstand cold or frost.

Scrim, muslin, or even newspaper gives good protection from spring or autumn frosts. Trials in England and the U.S.A. have shown an actual gain in temperature of between 5 and 6 degrees F. beneath muslin or hessian. Cloches, tiles, flat wood, or tarred paper may be used effectively. For valuable crops such as strawberries a light frame is well worth the cost. It can be made of battens with a covering of scrim to which is attached a 6ft. length of light wood or an old broom handle so that the scrim can be rolled up.

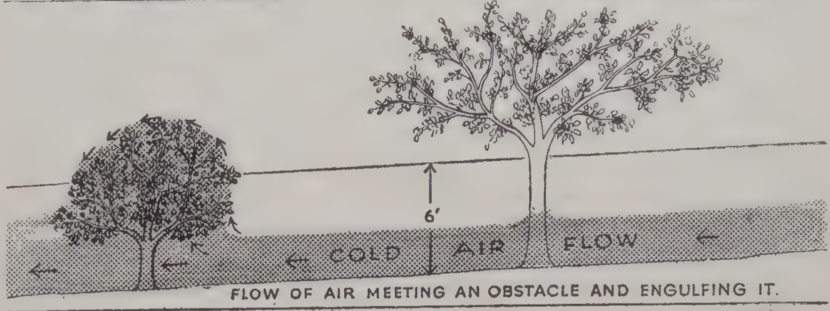
Covering up should be done before sunset when the ground is still warm, for the longer the operation is delayed the greater the heat loss through radiation.



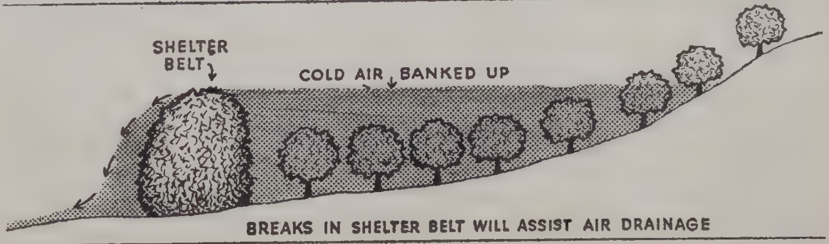
WRONG PLANTING
AIR DRAINAGE IMPEDED



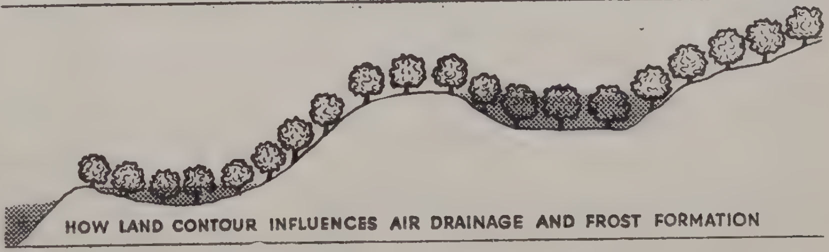
CORRECT PLANTING



FLOW OF AIR MEETING AN OBSTACLE AND ENGULFING IT.



BREAKS IN SHELTER BELT WILL ASSIST AIR DRAINAGE



HOW LAND CONTOUR INFLUENCES AIR DRAINAGE AND FROST FORMATION

Finally, sloping land can be planted or hedges trimmed in a way that permits effective drainage of cold air and so avoids the worst effects of comparatively-shallow spring and autumn frosts. Nothing can be done, of course, to combat winter frosts, which in the colder parts of the country bank up to great depths and cover the whole countryside, but it is not usual for the home gardener to grow frost-tender vegetables in winter.

Artichokes

Artichokes are easily grown and are well worth a place in gardens having sufficient space. Plant the tubers (either cut or whole) 3 to 4in. deep and 15 to 18in. apart in rows 3ft. apart. Three pounds of tubers will plant 100ft. of row. Artichokes are very hardy and are rarely troubled by disease or insect pests. They do not require any particular type of soil, but do well in a fertile, well-worked loam.

Asparagus

Established asparagus beds should be kept free from weeds and may be fed with liquid manure. Liquid manure made from organic material as described in last month's "Journal" is excellent, not the least of its advantages being its safety of application. As an alternative nitrate of soda applied at the rate of 1oz. a square yard will give good results.

It is not too late to plant new asparagus beds, and in the south conditions are often more conducive to growth in September than in August. Prepare the bed by digging deeply and clearing the ground of weeds and applying organic manure. Plant one- or two-year-old crowns 8in. below soil level with the roots spread evenly over small heaps of soil in the bottom of the trench, and cover the top bud with only 2in. of soil until the young plant is properly established. The remainder of the soil can be returned as the plant develops.

Beet

A successional sowing of beet can be made toward the end of the month. After an early sowing of the turnip-rooted or globe variety it is a good plan to sow an intermediate or long variety for the main crop. Where a first sowing is being made a small sowing of the turnip-rooted variety can still be made and the long variety can be sown a little later. Good varieties are Derwent Globe, Detroit Dark Red, and Obelisk (Intermediate). Beet does well in ground that was heavily manured for a previous crop, but if fertiliser is needed blood and bone mixed with twice its weight of superphosphate and broadcast at the rate of 3oz. a square yard, with a good dressing of wood ashes well worked into the topsoil before sowing the seed, will give good results. Sow ½in. deep in rows 12 to 14in. apart and later thin the plants about 4in. apart.

Brussels Sprouts and Broccoli

An early sowing of brussels sprouts can be made at the end of the month. They are a delicious vegetable and have a well-deserved popularity. Many home gardeners in the warmer and drier parts of New Zealand consider brussels sprouts difficult to grow because of the attacks of the grey aphis (*Brevicoryne brassicae*). Regular spraying with nicotine sulphate (1oz. to 4 gallons of water plus 2oz. of soft soap) should ensure that the plants are kept clean. It is important that coverage should be complete and if possible a hot, still day should be chosen for the work. Seed of brussels sprouts should be sown ¼in. deep in rows 1ft. apart. The seed-bed should be rich in humus and well worked and the surface of a fine tilth. The young plants should be ready for setting out in about 2 months' time. An early sowing of winter cauliflower (broccoli) can, if desired, be made at the same time as the brussels sprouts, the requirements for sowing, planting out, etc., being the same.

[*Sparrow Industrial Pictures Ltd. photo.*

Brussels sprouts are considered by many home gardeners difficult to grow because of the attacks of grey aphis, but regular spraying with nicotine sulphate will ensure that the crops are kept clean. Silver beet is one of the easiest vegetables to grow in the home garden because of its resistance to most diseases which attack greenleaf crops.

Carrots

In most districts the main carrot crop may now be sown if soil conditions are suitable. In many gardens the small sowings made earlier will provide a supply sufficient to make this one of the less urgent jobs, and sowing may be deferred for another month. Where the depredations of the carrot rust fly are severe serious infestation may be minimised by sowing the seed of the main crop in late November or December. The seed-bed should be as far as practicable from where the previous infected crop was grown. Horticultural naphthalene broadcast at the rate of 1oz. a square yard is a good repellent; it does not damage the foliage and should be applied during the period of growth. The carrot rust fly (*Psila rosae, F.*) has not yet been officially recorded in the South Island, and any home gardener who has reason to suspect its presence there should advise his local field officer of the Department of Agriculture. The rust fly is a small, two-winged, shining black, yellow-legged fly about 1/6in. long. It lays its eggs in soil adjacent to developing carrot roots, and the legless maggots enter the lower end of the carrot and work up. The maggots grow up to 1/3in. long and leave small rusty-coloured tunnels through the roots. Young plants wilt and die.

The rust fly should not be confused with the carrot aphis (*Cavariella aegopodii*), which commonly attacks carrot foliage in all parts of New Zealand. It is easily controlled by regular spraying with nicotine sulphate 1:800 (1 fluid ounce of nicotine sulphate to 4 gallons of water and 2oz. of soap). It should be applied if possible on a hot still day and complete coverage should be aimed at. Late-sown carrots sometimes escape aphis attack, and for this reason some growers defer sowing the main crop until late December or early January.

Cauliflower

A further sowing of cauliflower may now be made. Early September is a favourable time, particularly in the south, for outside sowing. Varieties that mature in from 3½ to 7 months are available. Any good seedsman's catalogue will give a list with descriptions and maturity dates. As the cauliflower, unlike broccoli, is liable to frost damage, the varieties chosen should mature before there is likelihood of heavy or even moderate frost. Sow ¼ to ½in. deep in a specially-prepared bed in a warm sheltered position as advised in last month's "Journal." The young plants should be ready for setting out in 6 to 8 weeks.

Celery

Celery can be sown outside in September in the warmer parts of New Zealand, but elsewhere it is better sown under glass. Wherever sown it is important that the temperature be kept up throughout its growing season, and for this reason many home gardeners prefer to buy plants in the December-January period for setting out in the field then, when more even temperatures are assured. Loss of celery as the result of premature seed development is common among home gardeners, and it is worth while to quote from the United States Farmers' Bulletin No. 1269, "Celery," which describes experiments carried out at the Cornell Experiment Station, New York State College of Agriculture. The bulletin states:—

"In these experiments it was found that bolting to seed was due primarily to subjecting the plants to low temperatures during the growing period. The seed used in these experiments was planted on December 10, January 10, February 10, February 25, and March 10. [New Zealand equivalents are June 10, July 10, August 10, August 25, and September 10.] The resulting plants were divided into several lots for different treatments. Some were kept dry, and comparison lots were normally watered. Other lots were frozen and still others kept in cold frames at temperatures below 50 degrees F. but above freezing. In every case where the plants were carried in the cold frames at temperatures below 50 degrees F. for a period of 2 weeks or more there was a high percentage of seeders. Plants from the same seedbeds kept in the greenhouse at temperatures above 65 degrees did not produce a single seeder in the field, whereas as many as 95 per cent. of those kept in the cold frames for 30 days were seeders.

"It was also found that subjecting the plants to higher temperatures following their being kept at low temperatures would as a rule prevent their bolting to seed, provided the seed shoot had not started before the change to a higher temperature was made. A period of 2 weeks or more of low temperature after the plants were set in the field might also cause bolting to seed, though a corresponding period of high temperatures immediately following might correct this injurious effect of the low temperature period and prevent bolting."

It is usual to sow celery seed in a box of fine, specially-prepared soil, and when the seedlings are large enough to prick out they are placed about 2¼ to 2½in. apart each way in the boxes from which they will ultimately be planted in the field. The seed box is kept at a temperature of about 70 degrees F. or as near that as possible, and the seedlings after pricking out are gradually hardened off.

[*Sparrow Industrial Pictures Ltd. photo.*

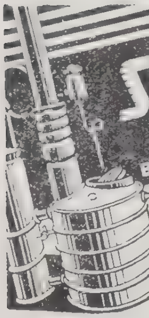
Runner beans can be grown in a small space in the home garden by being trained up long manuka stakes placed along a fence or wall. The stakes allow full and early development of the vines, facilitate picking, and keep the vines tidy.

Frost-tender Vegetables

It is a good plan to make sowings of such tender plants as pumpkin, marrow, cucumber, pepper, and cape gooseberry in boxes in a heated frame or hotbed. The actual date of sowing will depend on the incidence of frost, the recognised safe dates for planting out frost-tender plants varying from about mid-October in the north to mid-November in the south. Tomatoes and cape gooseberries require about 6 weeks, depending on the conditions under which they are grown, to reach a suitable size for planting out, but about a month is usually sufficient for marrow, pumpkin, and cucumber, which, unlike tomatoes, are usually sown thinly in the boxes from which they are planted out in the field. It is not advisable, therefore, to sow too early, as the plants may become too big to be conveniently handled at planting time. Cape gooseberries and tomatoes are as a rule sown thinly in pots or boxes and later pricked out about 2¼ to 2½in. apart each way in boxes of John Innes seed compost, described in the last issue of the "Journal."

Beans, Marrow, Pumpkin, and Cucumber

In a few parts of the North Island cucumber, marrow, pumpkin, and French, runner, and snap beans may be sown outdoors in mid-September, but in most other districts in the north it is better to wait until mid- or late October. In the south in most districts there is danger of frost until early or mid-November and sowing should therefore be deferred until at least the end of October. Pumpkins and marrows are gross feeders, and the area where they are to be grown should be enriched with organic manure or well-rotted compost. Marrow and squash are available in both trailing and bush varieties, the latter being more compact in growth. Sow the seed 1in. deep and 18 to 24in. apart in rows 4 to 5ft. apart, or in hills 4 to 6ft. apart. One ounce of seed will sow about 100ft. of row. If the hill method is chosen, it is advisable to sow 6 to 8 seeds to each hill and thin



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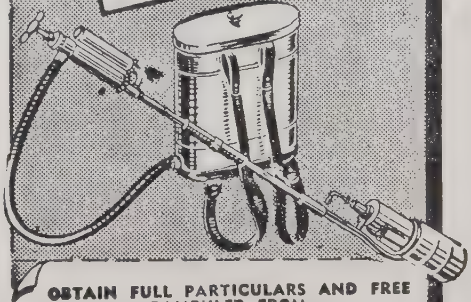

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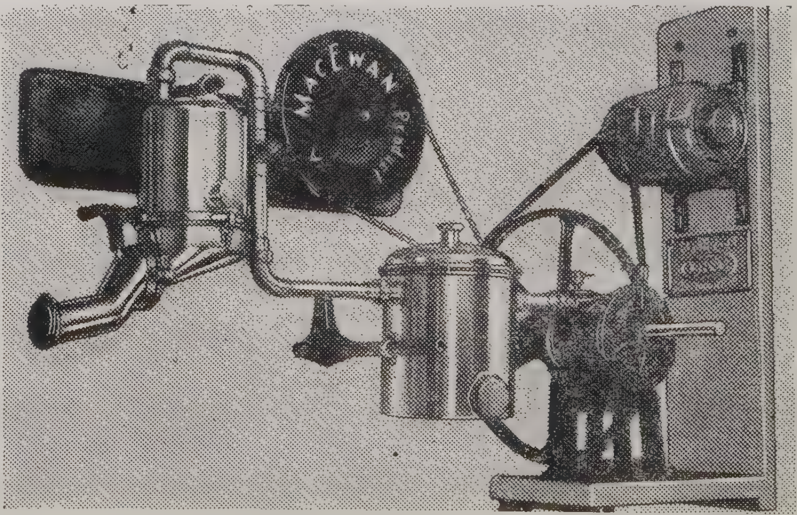

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to 3 to 4 plants when growth is established. To make a hill 1 cubic foot of soil should be removed, the hole filled 9in. deep with manure, and the top 3in. of soil replaced. Sow the seed round the edges, not directly above the manure.

Leeks

Few vegetables are as easily grown and yet are as useful as leeks. They suffer little from insect pests or diseases and are available as fresh vegetables in more districts for a longer period of the year than almost any other vegetable. Though very accommodating, leeks respond especially well to liberal manuring and good soil conditions. They may be grown to a considerable size without sacrifice of quality and are perfectly hardy in the severest weather in any part of New Zealand. Plants are usually set out in the December-January period, and a first sowing may now be made in a warm position in soil that has been thoroughly cultivated and worked down to a fine tilth. Sow thinly ½in. deep in rows 12in. apart. Half an ounce of seed will plant about 100ft. of row. (There are about 9000 seed to 1oz. and germination of one-year-old seed is usually about 80 per cent.)

Onions

In the South Island main crop onions should now be sown if ground conditions are favourable. The seed-bed should be well drained and worked to a fine tilth. It should be firm and should have been previously enriched with organic manure; poultry manure is especially good. In the absence of organic manure or when it is in short supply superphosphate (or even blood and bone) at the rate of 2oz. a square yard should be broadcast. Potash fertiliser at the rate of 1oz. a square yard can also be applied with advantage. In its absence a heavy dressing of wood ash, which has a relatively-high potash content, can be applied. Sow ½in. deep in rows 12 to 15in. apart. Except on heavy land, it is not essential to thin; commercial growers on light land do not. Autumn-sown onions should be kept cultivated and free from weeds. In the North Island onion plants from autumn sowing can still be set out.

Parsnips

A sowing of parsnips may be now made. In the south September is preferred for sowing, but there, as elsewhere, sowing can be deferred for another month. In the north winter supplies are often produced from a sowing made as late as November. Sow ¼ to ½in. deep in rows at least 15in. apart and thin to 4 to 8in. apart as soon as the young seedlings are established.

Peas

In gardens where peas have not yet been sown they should be put in without delay if soil conditions are favourable. The length of time during which each pea crop can be harvested is strictly limited, and successional sowings are usually advisable. Peas do well in a cool, well-drained soil rich in humus. They repay good cultural methods, and the ground should be deeply dug and manured, preferably in the autumn, with organic material such as stack bottom, compost, or farmyard manure, and the surface left in a rough state to weather during the winter. Before sowing in the spring a dressing of 2 to 3oz. of superphosphate to the square yard should be well worked into the soil, and if a shallow trench is first taken out and the seed pressed into the bottom of it 1 to 1½in. deep (according to whether the soil is heavy or light), the plants can be conveniently earthed up as soon as they show a tendency to straggle or fall over between the rows. Dwarf varieties such as Massey can be grown without staking in rows 20in. apart if they are kept well earthed up. The medium and tall varieties should be planted at least 3ft. apart and require staking. Material such as brushwood, netting, or sticks can be used. It is important that the vines be supported so that they will not provide a refuge for slugs, which eat the pods. Staking also prevents the pods from rotting through contact with the soil. If slugs are troublesome, they can be controlled by dusting the ground with a mixture of 1oz. of bluestone (heated until it has broken down) and 5oz. of hydrated lime. Dusted on the ground, it kills on contact. It is best applied with a blower in the evening. Care should be taken not to apply too much, as it may come in contact with the plants and damage them. Alternative control measures were given in last month's "Journal."

There are many good varieties of peas available, and any good seedsman's catalogue will give a list with descriptions. The following have proved popular with home gardeners: W. F. Massey (early) (=Kelvedon Wonder), Greenfeast (=Lincoln), Richard Seddon, and Stratagem. One pound of pea seed is sufficient for about 100ft. of row.

Perennial Crops from Seed

Asparagus seed may be sown in September or October if ground conditions are favourable. The soil should be well-drained and of a fine, firm tilth with good humus content. Sow the seed thinly ½in. deep in rows 18 to 24in. apart and thin the seedlings later to 4in. apart in the rows. In August or September (according to climatic conditions) of the following year the young plants should be set out in their permanent positions. If desired, the young plants can be left in the seedling rows for 2 years before setting out in their permanent positions, but they should be thinned in the rows to 8in. apart and greater care must be exercised in shifting them.

Top growth 7ft. 6in. high and 16½lb. of tubers from one root of Up to Date potatoes grown by Mr. A. Clark, Upper Hutt.

Rhubarb

Though most home gardeners prefer to establish new rhubarb beds with crowns bought in from outside sources or by division of crowns grown in their own gardens, rhubarb can easily be grown from seed sown in the spring 1in. deep in rows 15in. apart in any fertile, well-drained soil. The seedlings should be thinned to about 6in. apart as soon as they are properly established. Young plants can be set out in their permanent positions early the following spring. Few, if any, stalks should be pulled until the second year after establishment. The ground for the new bed should be rich in humus and well drained, and should not be overshadowed by trees.

Potatoes

It is not yet safe to plant potatoes in the South Island, except in a few specially-favoured districts. In the north they may be planted in districts reasonably free from late frosts. The greening and sprouting of the tuber is not essential, but it is an advantage; sprouted potatoes are earlier and less liable to rot. If, therefore, it is not intended to plant at once, it is a good plan to obtain seed and place it in a light, airy, frost-free place so that the tubers green and sprout. Care should be taken to ensure that the sprouts do not become too long, as they are then liable to break off when planted. If there are several strong shoots, it is desirable to reduce the number to about three by rubbing the remainder off, or if the tuber is large enough, by cutting it in half. The soil for potatoes should be deeply dug and well drained with an abundance of humus.

Organic manure such as stable or farmyard manure is excellent, but should preferably have been applied the previous autumn. Where manure is unobtainable it is advisable to supply humus by digging in a green crop or grass clippings or such garden trash or compost as is obtainable. The fertiliser requirements of potatoes depend to some extent on the amount of humus-forming material previously incorporated in the soil, but in general it has been found that a mixture of 3 parts of superphosphate and 1 part of sulphate of ammonia gives the best results. This mixture can be applied at the rate of from 6 to 12oz. to every 6 yards of row. Alternatively, equal parts of superphosphate and blood and bone may be used.

Advantage of Certified Seed

It is advisable to obtain Government Certified seed, as the yield from it is consistently higher than that from uncertified. If it is intended to use large tubers and cut them, care should be taken to see that, first, at least one good eye is left in each section; secondly, that the sections cut are as uniform in weight as possible and not less than 1½oz. each (preferably much more); and thirdly, that portions showing weak buds are discarded. Cut seed should be planted as soon as possible, as it is courting failure to cut and store the seed for several days before planting. Dusting with lime, ashes, or sulphur is not necessary. Some varieties heal more quickly than others. The sequence during the healing of the cut surface is as follows:—

1. The first process is the deposit of a fatty layer in the tissues of the cut surface. If the cut surface is exposed to a moist atmosphere, the layer is continuous, but if exposed to sunlight or a dry atmosphere, the layer may have gaps.

2. The layer forms in 12 to 48 hours, and later cork is formed below the deposit as a result of cell division.

3. The activity of the cork phellogen may be estimated roughly by the number of layers of cork produced.

If the original fatty suberin layer is patchy (as will be the case with tubers exposed to dry conditions), the subsequent cork will also be irregular, with the result that disease may penetrate the tubers.

Planting may be done in several ways. Perhaps the most satisfactory is to open a trench 4 to 5in. deep and dust the fertiliser along it. Place the tubers in the trench 10 to 16in. apart (early potatoes are planted closer than main crop varieties). Planting trials carried out by the Ministry of Agriculture for Northern Ireland seem to indicate the soundness of close planting. Three plots with potatoes in 27in. drills were tested for 2 years. The yields were as follows:—

	Per acre	
	ton	cwt.
10in. between sets ..	16	17
15in. between sets ..	13	4
20in. between sets ..	11	19

A favourable feature of close planting was that the tubers produced were invariably more uniform in size and shape and more attractive for marketing than those grown with wider spacing. For the home garden the trenches can be 24 to 35in. apart, the narrower distance being preferable for early potatoes. Treatment after filling in the trench is confined to keeping down weed growth, ensuring that the tubers are kept well earthed up, and, where frost is expected, providing protection. Where blight is of regular occurrence it is advisable to apply a Bordeaux spray before the blight appears. To ensure adequate coverage several sprays throughout the season may be necessary.

The most popular early variety is Epicure, but Arran Banner, though not a true first early variety, can be dug almost as soon, and if left, will produce a much heavier crop. It is not, however, a good keeper and should be used soon after digging. Though a brassica-potato rotation has much to commend it and is commonly practised by commercial and home gardeners alike, it has one important drawback if club root is present. To be free from scab the potato requires an acid soil; soil with a pH of 5.4 is usually safe, though the organism is not completely checked until a pH of 4.5, which is very strongly acid, is reached. Club root on the other hand tolerates acid conditions, but is inhibited by an alkaline reaction (which is, of course, produced by the application of lime). It is obvious, therefore, that potatoes and brassicas cannot be grown in rotation with success in soil that harbours scab or club root.

Salad Vegetables

If not already done, seed of salad vegetables should be sown without delay, but if a sufficient period has elapsed since the last sowing, successional sowings should be made.

For lettuce grown early in the season, when conditions are cool, a variety such as Imperial 615 is especially suitable. Later a variety such as Imperial 847, which has been especially developed for summer conditions, can be chosen. Sow ½in. deep in rows 12 to 15in. apart in well-drained, deeply-cultivated soil of high humus content. Early in the season lettuce can be successfully transplanted. They are usually set out 8 to 12in. apart. Hot, dry, summer conditions may later make it more effective to sow very thinly and thin to 8 to 12in. apart in the rows.

Radish

The maintenance of successional sowings of radishes is very important, as they do not "stand" long in the ground before deteriorating. For crispness and quality they should be grown quickly. Sow thinly every 3 or 4 weeks ½in. deep in rows 12in. apart in well-drained, free, deeply-dug soil that contains plenty of humus. The Chinese type, which sometimes grows to more than 2lb., should be thinned to 6in. apart. Radishes are available in long, round, and oval-shaped varieties.

Spring Onions

For the best results spring onions should, like radishes, be sown successionally. White Lisbon or Odorless are quite good for pulling young for salads. Sow ½in. deep in rows 12in. apart in a well-drained soil that has been worked down to a fine, firm tilth.

Turnips

For good-quality produce it is essential that turnips, like radishes, should be grown quickly. Early in the season varieties such as White Stone or White Milan are suitable, but for summer use Golden Ball or Purple Prince are better. Culture is similar to that of the radish, except that turnips should be thinned 3 to 4in. apart.

Spinach and Silver Beet

If not already done, sowings of spinach and silver beet should be made at once. They are easily grown at this time of year, and where there is a partiality to them, successional sowing should not be overlooked.

Drawings reproduced from "Frost and the Fruitgrower," Raymond Bush.

Experiments and Investigations by the Fields Division

One of the plots (outlined), which extend to 2600ft. above sea level, on depleted country in the Dunstan Range, Central Otago. A series of these plots laid down some 20 years ago by the late Dr. L. Cockayne, is being maintained and observed at present under the co-operative trial scheme.

By P. B. LYNCH,
Crop Experimentalist, Fields Division, Wellington.

NEW ZEALAND is a comparatively young country, and, though agricultural practices of the older countries were naturally adopted by the early settlers, it was soon found that many were not applicable to this new country and they had to be modified or abandoned. As farming became established State experimental farms were set up, and in the last decades of the past century and the first 20 years of this century they gave valuable service by introducing new breeds of stock into the country and strengthening the blood of existing breeds and by determining crops and pasture species that were suitable and methods by which these crops could be grown successfully. In the early twenties it was found that these farms had practically outlived their usefulness and they were gradually closed, while a new type of work was introduced to take their place. By that time breed societies and leading breeders were doing what was considered necessary to look after livestock introductions, but there remained the task of research into animal disease and into crops and pastures. The position was met by the establishment of research stations and by the adoption of the principle of co-operative experiments.

THE co-operative experiments are a highly satisfactory means of conducting practical research into farming problems, but there is still a need for experimental farms on which investigations requiring constant attention or stock manipulation and which would seriously interfere with normal farming practice can be carried out. Until the establishment of the Soil Fertility Research Station near Hamilton last year the Marton Experimental Area was the only farm retained by the Fields Division solely for experimental work. In other areas the position was partly met by carrying out detailed field trials on demonstration farms. Such farms are located at Dargaville, Stratford, Hawera, and at Winton in Southland. The necessity for experimental farms in Canterbury and Otago became increasingly urgent; that in Canterbury has been established recently, and it is hoped that the Otago-Southland farm will be in operation in the near future. Special research into irrigation is the major investigation at the Canterbury farm (known as the Winchmore Irrigation Research Station), but other general cropping and pasture problems will be subjects of experimental work.

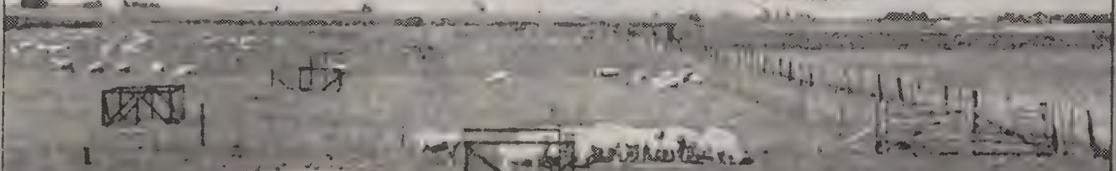
Co-operative Experiments

Co-operative experiments are carried out on existing farms in co-operation with the farmer, and the advantages of this system are twofold. First, the trial is carried out under existing farming conditions—the work and the conditions of management are those of the average farmer; secondly, a much greater number of trials can be undertaken and a greater variety of soils and climatic factors can be covered.

The usual method adopted is to attack some problem common to a district and then approach interested farmers in that district with a view to placing trials on their properties. If it is a question of grass seed mixtures, a farmer sowing down a paddock to grass may volunteer to co-operate by placing the whole or part of the paddock at the disposal of the Fields Division. The farmer then carries out the cultivation work and when the paddock is ready to be sown the Instructor will set out the plots and sow them with seed mixtures comprising the trial; the seed is supplied by the Department of Agriculture. The plots are clearly marked with pegs and from time to time the establishment and production of the pasture mixtures are observed. A copy of all reports is sent to the co-operating far-

EXPERIMENTAL WORK BY THE FIELDS DIVISION

Right—Cutting a sample sheaf from a co-operative experimental crop for the estimation of wheat yield by sampling methods.



Above—A topdressing trial at the Winton Experimental Farm. The movable enclosures are used to obtain pasture production records, and the sheep grazing in the same fields give animal production records. Left—Mowing the pasture growth for weighing on an area that has been protected by an enclosure or "cage."

mer so that he is kept well posted about the progress of the trial, though in most cases he is the most interested observer of the plots.

The procedure is the same with other subjects that require investigation, such as new varieties of cereals and root crops, manures and manure mixtures on both crops and pastures, and pampas grass. Each is the subject of one or more co-operative trials. The results are used extensively in the extension work, and much of the advice given is based on these trials.

Trials carried out during the past few years can be classified under the following headings: Pasture topdressing; species and strains trials with grasses and clovers; varietal and manurial trials with annual crops; and miscellaneous.

Pasture Topdressing Trials

The objective in observational trials is to secure general information. A large number of experiments is laid down, each consisting of a duplicate series of plots. Each trial is established on a pasture under an average grazing management for the district, with a known history, and wherever possible on a clearly-defined soil type. The accuracy of the information secured from observations taken at regular intervals over a minimum period of three years depends on the number of trials laid down and the coverage of soil types, climate, and farming conditions. It is usual to have about 300 trials of this type laid down throughout the Dominion for each project undertaken.

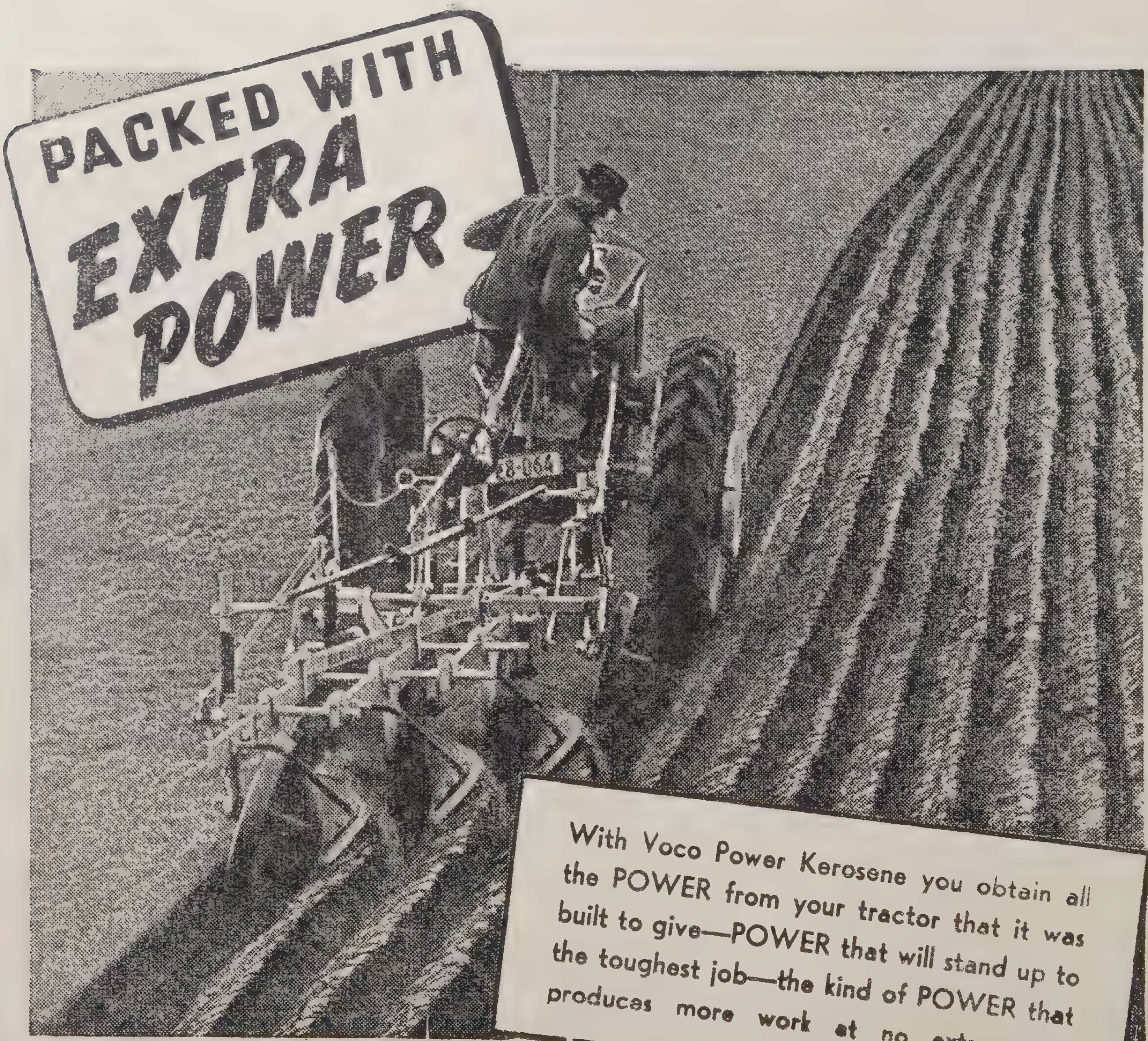
From observational topdressing trials it has been possible to define broadly the lime-responsive areas, to recommend the most suitable form and rate of application of phosphate for use under varying conditions of soil and climate, and to define the potash-responsive districts throughout New Zealand. They have also been one of the means of investigating the merits of serpentine superphosphate as a pasture topdressing. This pasture topdressing investigation is carried out with the co-operation of the Soil Bureau, Department of Scientific and Industrial Research, which defines the soil types. Analyses are made of the soil of each trial, and these check the field results and also assist in selecting the most satisfactory analytical method.

In half-paddock trials a field is subdivided and differentially treated and grazed according to production, thus supplying grazing data to supplement observations. Trials carried out under this system have given information about the response from topdressing and the production and economic use of different species and strains of pasture plants.

Wherever possible mowing trials are laid down to provide production figures to supplement information from observational trials. One of the most satisfactory techniques now adopted involves the use of movable wire-netting enclosures 11ft. square or 11ft. by 5ft. 6in. They are strong enough to keep out sheep or cattle but light enough to be moved easily. The procedure is to allow the specially-sown or topdressed areas to recover after being grazed and then to trim the herbage to an even level. The enclosure is placed on this area, and when at grazing height the herbage is cut with a mower and weighed. The result represents pasture production for the period between trimming and weighing, but to secure continuous records the enclosures are used in duplicate, so that when the growth in one is being trimmed that in the other is cut and weighed. Replication

Taking a soil sample on one of the trial areas. A composite sample is obtained from a number of these "cores" taken from each treatment to specified depths. Such samples are thoroughly mixed and "quartered down" until a small representative sample suitable for chemical analysis is obtained.

A general view of some of the trials now in progress on the Marton Experimental Area. The cropping trial area is in the foreground.



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A co-operative oat variety trial showing the layout of the plots and differences in types of growth between varieties.

of the number of small fields in which enclosures are placed overcomes the effect of soil fertility variation, and the number of treatments is limited only by such practical considerations as time and labour.

From soil samples taken at the start, during the progress, and at the completion of trials the effect of each treatment can be studied. The uptake of plant nutrients can be calculated from pasture samples taken from each cut, and dissections of herbage samples into the species that make up the sward provide data from which to construct graphs showing the performance of each species in the sward at all seasons of the year.

Species and Strains

On a layout similar to that employed in observational topdressing trials a number of small plots has been established, each sown with different pasture species or combinations of species and strains of grasses and clovers, and results have been recorded over a minimum period of three years. This work requires really critical observation by instructors as, in addition to recording growth differences, such points as palatability (shown by preferential grazing), the balance between grasses and clovers, the influx of volunteer species, and the relative permanence of sown sward constituents must be noted.

Grazing trials have been conducted under the system described for half-paddock trials, and comparisons between species and strains as sown in observational plots have been made on a field scale. As the seasonal production, palatability, and permanence of the species are important in trials of this type, the grazing data are of considerable value. Observations are also taken as in the purely observational series.

Mowing trials with new pasture species and strains are carried out at the Marton Experimental Area with the co-operation of the Grasslands Division, Department of Scientific and Industrial Research. More recent experiments are being conducted at Marton and Winton under the enclosure system, and results are such that, as with topdressing trials, the work on species and strains will be extended as rapidly as possible.

Annual Crops

Varietal and manurial trials with annual crops form an important section of the work. In most instances only one measurement of yield is made each year, so the evaluation of treatments is usually simpler than with pasture trials. Quite complicated experiments can be carried out successfully in the field under the co-operative trial scheme and yield accurate and valuable data.

Experiments are carried out regularly with wheat, oats, barley, swedes, turnips, rape, chou moellier, linen flax, sugar beet, onions, lupins, and maize, to name the more common crops. In addition, field trials with recently-introduced species sometimes produce valuable results. A case in point is linen flax. Experimental work conducted with this crop before the necessities of war made the growing of flax in New Zealand urgent enabled the planned and successful growing of a crop entirely new to New Zealand farming.

Miscellaneous Trials

Vegetable growing on Departmental areas showed the necessity for investigational work, and a wide range of experiments was laid down on a special block at Papatoetoe and on many areas in other districts. As a result, considerable information is available about the most suitable methods of cultivation, sowing, manuring, inter-cultivation, and harvesting of a wide range of crops in the production of which modern machinery and methods were used. In a special series of trials the control of pests, diseases, and weeds and the value of minor elements were studied.

Other miscellaneous trials involve the investigation of such problems as pasture establishment, using various methods of seed-bed preparation; erosion control, involving the establishment of various local and imported pasture and shrub species; pampas grass establishment and utilisation, including the use of plants from various sources; weed control, using recently-devised and the older forms of specifics, as well as flame-throwers; grass-grub control; and, more recently, an investigation into the value of the casting worm in improving hill-country pastures.

The investigational work of the Fields Division is expected to be expanded and the projects extended to cover the principal problems encountered by farmers throughout the Dominion. Results from all projects are transmitted to instructors, who are able to pass them on to farmers through the already-established means of contact. The investigational work now in progress and planned for the future is aimed to assist farmers over a wide range of soil types, climates, and farming systems throughout the Dominion, and the fact that results from such work are quickly absorbed into farming practice indicates both the necessity for the work and the appreciation of it by those engaged in primary production.

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FARMING IN NEW ZEALAND

Meat, Wool, and Dairy Produce

THE genesis of the practice of topdressing grassland with phosphatic fertilisers was described in the previous article in this series, and in this article P. W. Smallfield, Director of the Rural Development Division, traces the progressive expansion of the dairy and meat industries in the first two decades of the present century and describes how more intensive grassland management methods were gradually adopted.

THE development of dairying after the introduction of refrigeration opened the way for closer settlement. Wool, meat, and cereal production, on which the country's economy was previously based, required comparatively large areas of land, but with the advent of dairying it was possible for the State to proceed confidently with its closer settlement plans in the North Island. Further thousands of farmers who had struggled for years at a subsistence level on small farms and who had previously depended for a living on gum digging, fungus picking, or casual work in the timber or phormium industries set about gathering together a small herd of cows with the prospect of securing a regular cash income from their farms.

The majority of the settlers entering the dairy industry had little money and both the settlers and those controlling the manufacture of butter and cheese had to accept at first very makeshift conditions. Milking sheds were often poorly built and ill ventilated, with floors of wood, earth, or stones, and no proper drainage. On the roads and farms winter mud and summer dust vexed both the farmer and factory manager. The cows were generally of poor quality and usually insufficiently fed in the winter. From these primitive conditions in 1900 there gradually emerged by 1921 the efficient dairy industry that is established today. Pastures were increased in production and feeding value through the magic of topdressing; milking sheds were improved in design and concrete floors and yards introduced; the milking machine was widely adopted and the handling of milk and cream on the farm and in the factory was improved and systematised. To a very large extent these developments were guided by the Department of Agriculture through its dairy, fields, and livestock officers, and the work of the professional instructor began to bear an increasing share in the development of New Zealand farming.

While the dairy industry was being developed further progress was made in the meat and wool industries. The great forests of the middle western portion of the North Island were opened for settlement, and the way was made easy through leasehold tenures and State advances to settlers for the man with small capital to start sheep farming. A few hundred pounds and a bushman's outfit of tent, axes, saws, and wedges were sufficient assets to secure a leasehold Crown section.

The development of fruit and vine culture, poultry farming, beekeeping, and other forms of intensive farming also received attention. Farm development embraced not only the taming of the wilderness of bush and fern, but also the more intensive use of land already partially broken in.

The major developments were, however, based on grass farming, and it was in the first two decades of the present century that scientific men began a really systematic study of the country's pastures and pasture plants. It was their foundation work which made possible the great advances in intensive grassland farming during the past three decades.

Sown Grasslands

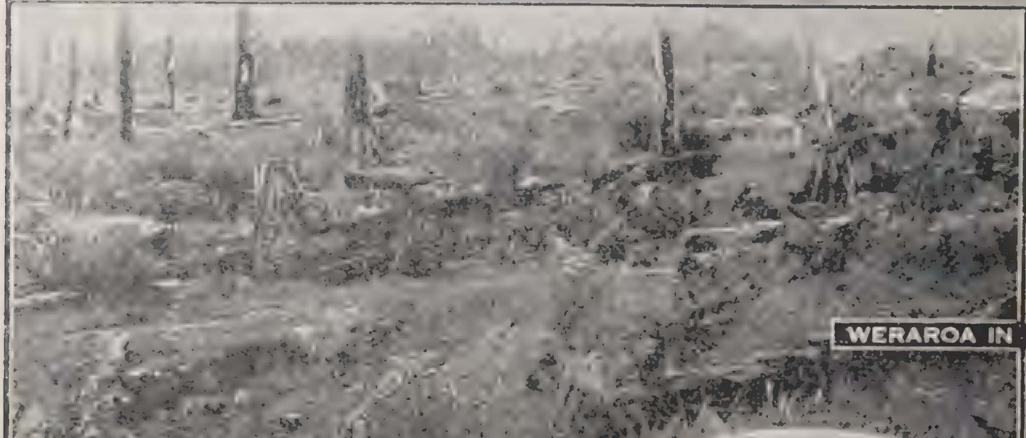
The main development in sown grasslands between 1901 and 1921 was in the extension of surface-sown pastures, particularly in the North Island. Unfortunately statistics do not provide details of the comparative expansion of pastures sown after ploughing and by surface sowing throughout the period, but a summary of the available data is given in Table I.

Apart from the development of dairying, covering an increase of about 100,000 dairy cows, South Island farm-

TABLE I—SOWN PASTURES (millions of acres)

	North Island.			South Island			
Year.	Ploughed land.	Surface sown.	Total Sown Grass.	Ploughed land.	Surface sown.	Total Sown Grass.	N.Z. Total sown grass.
1901	1.5	5.6	7.1	3.2	1.3	4.5	11.6
1906	1.4	6.3	7.7	3.2	1.4	4.6	12.3
1911	1.7	7.4	9.1	3.2	1.7	4.9	14.0
1916	N.A.	N.A.	10.1	N.A.	N.A.	4.6	14.7
1921	N.A.	N.A.	11.1	N.A.	N.A.	4.8	15.9

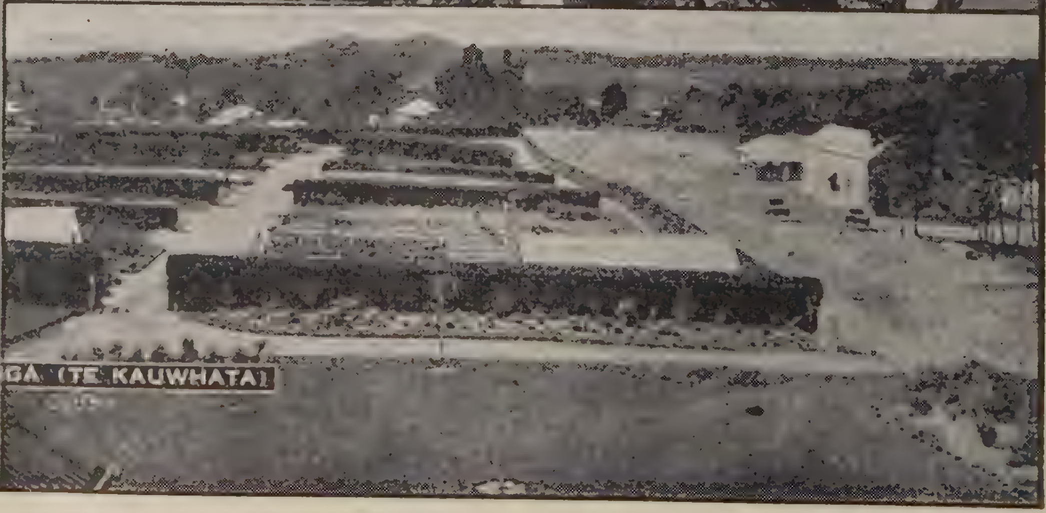
LARGE MIXED EXPERIMENTAL FARMS



WERAROA IN 1902

Clifton organised the establishment of Ruakura, Waerenga, Weraroa, and Moumahaki as large mixed farms on which a great deal of experimental work was carried out, covering the trial of new varieties of cereals and fodder crops, grasses and clovers, topdressing and the fertiliser requirements of annual crops, the raising of fat lambs, and the development of the dairy, meat, poultry, honey, and fruit industries.

FERTILISER TRIAL AT MOUMAHAKI



WAERENGA (TE KAUWHATA)

ing changed very little between 1901 and 1921. Farm practice remained based on extensive pastoral farming of the tussock grasslands on the hilly and mountainous country and on mixed arable farming on the plains. There was a slight extension of the surface-sown grassland area, but total sheep increased by only half a million.

The great expansion was in the North Island, where sown grasslands increased by 4 million acres, dairy cows by half a million, and total sheep by 2½ million. Further, it was the pasture problems of the North Island rather than of the South Island which received most attention from investigators.

In the early 1900's rotational farming was looked on as normal practice on large areas of North Island ploughable land which had been originally reclaimed from scrub and bracken fern. Pastures of perennial ryegrass, cocksfoot, and clovers were rotated with cereals and fodder crops. Although phosphatic topdressing had commenced, it was not generally anticipated that in the higher-rainfall areas it would enable rotational pastures to become permanent. Topdressing merely gave promise of a higher annual production and a slightly longer life from pastures. Further, it did not seem possible that the use of phosphates would enable poor scrub land to carry high-class pastures.

Attention was focused on the best means of securing permanent pastures on the poorer ploughable land where rotational farming was uneconomic because of the low yields of annual crops and the hazards of harvesting cereals in the high-rainfall districts. If the land was not fertile enough for the permanence of white clover and perennial ryegrass, then low fertility demanding grasses such as sheep's fescue, danthonia, paspalum, ratstail, *Poa pratensis*, and Indian doab might be better than constant recourse to the plough. Accordingly in the early 1900's pasture improvers worked in two directions: On the one hand the Department of Agriculture was sowing down trial fields on poor ploughable land with danthonia, sheep's fescue, and other low fertility demanding grasses, and on the other it was putting down topdressing trials on better land to demonstrate the efficacy of phosphatic fertilisers in prolonging the life and increasing the production of rotation pastures. Two decades were to pass, however, before it was finally realised that white clover was the key to the problem, for if white clover could be kept vigorous through the application of phosphates or phosphates and lime, the problem of establishing a productive pasture was practically solved, although another decade was to pass before the truly perennial strains of ryegrass were sorted out and the development of poor ploughable land tackled with confidence.

. . . PASTURE ESTABLISHMENT AND MAINTENANCE

Though the improvement of pastures on ploughable land was important in the development of the dairying industry, the extension of surface-sown pastures was the major grassland activity in the North Island, and 2 million acres of bush land were felled and grassed between 1901 and 1911. Farmers were beginning to realise that over large areas the initial high fertility of the land following the bush fire could not be maintained and that low fertility demanding grasses should be included along with perennial ryegrass, cocksfoot, and clovers in surface-sown mixtures on unploughable land.

The development of thought and practice on pasture establishment and management methods between 1900 and 1921 is well exemplified in the writings of two men—E. C. Clifton between 1900 and 1912 and A. H. Cockayne between 1912 and 1921. Clifton was chiefly concerned with the development of pastures on poor ploughable land in the north and Cockayne, particularly in his earlier work, with surface-sown pastures.

[*Alan Blakey photo.*

E. C. Clifton

E. C. Clifton

Clifton's writings may well be used to interpret pastoral thought during the 1900-1912 period, for he wrote and spoke with authority and influence and he had a wide experience of the practical problems of New Zealand farming. Between 1900 and 1907 he was inspector-in-charge of the Auckland District; in 1907 he was appointed Chief Inspector of Stock and Director of Experimental Farms, and in 1909 he was appointed Director of the Fields Division and retired from the Department of Agriculture in 1916.

Clifton's work covered practically the whole field of farming, and the development of improved grasslands was only one of his many activities. He organised the establishment of the large North Island experimental farms—Ruakura, Waerenga, Weraroa, and Moumahaki—as large mixed farms on which a great deal of experimental work was carried out. This work covered the trial of new varieties of cereals and fodder crops, grasses and clovers, topdressing and the use of fertilisers, the raising of fat lambs, and the general development of the dairy, meat, poultry, honey, and fruit industries. As Chief Inspector of Stock he was also concerned with the rabbit nuisance and noxious weeds, dairy inspections, and the general health of the country's livestock. He knew the country and the farmers and his reports and speeches give an excellent picture of the condition of New Zealand farming during the first decade of the present century and the steps taken to improve farm practice.

In the early 1900's farmers, particularly in the Auckland district, were facing difficulties in pasture establishment and maintenance. It was becoming obvious that permanent pastures of perennial ryegrass, cocksfoot, and white clover could not be maintained on the majority of surface-sown bush land and that rotational farming on the poorer ploughable land was not profitable. Clifton at this time advocated the development of pastures with low fertility demanding grasses. He welcomed the invasion of danthonia into surface-sown pastures, stating, "Nature herself is effecting a beneficial transformation over the face of the country with the assistance of her own natural allies—the indigenous grasses of New Zealand. From North Cape to East Cape, along the west coast and through the Waikato, these grasses—danthonia (several varieties), microlena, and chewings fescue (this may almost be admitted as a New Zealand grass) — are everywhere increasing. These native grasses have taken advantage of the careful preparation made by our settlers for the reception of exotic grasses—ryegrass, cocksfoot, clovers, etc. These natives unostentatiously, and by the settler unwelcomed, replaced those earlier but fleeting guests designated under the generic name of English grasses. . . . "

He advocated the inclusion of danthonia and chewings fescue in surface-sown grass mixtures and carried out experiments on the grassing of poor ploughable scrub land with danthonia, chewings fescue, and paspalum. He

OPENING UP OF BUSH LANDS

Between 1901 and 1911 the area in surface-sown grass increased by 1.8 million acres and much of this pasture-land development took place on the bush lands of the western central district of the North Island, following the formation of the Main Trunk railway. The upper illustration shows the initial clearing work in railway formation and the lower one the pioneer stage in developing a bush farm, at a time when a few hundred pounds and a bushman's outfit were sufficient assets to secure a leasehold Crown section.

then looked on a permanent pasture of low fertility demanding grasses on poor ploughable land as a better alternative to having to plough every few years for the maintenance of rotational pastures of ryegrass and clovers.

In 1905, however, having seen the magic of phosphatic topdressing at Ruakura, he turned increasingly toward topdressing as a solution of the grassland farmer's problems. In his 1905 report he wrote, "One of the most, if not the most, disappointing aspects of agriculture in this district [Auckland] is the absence of profitable permanent pasturage except on lands that are of the most fertile description of volcanic soil. At Ruakura there is no old pasture of any stock-carrying capacity; there are certainly some acres in old grass, these consisting chiefly of sweet vernal, fog, some trefoil, and a little cocksfoot and fiorin. One of those old pastures in 1904 was stocked heavily, hay carted on to it and fed off, 2cwt. of basic slag applied, the whole well harrowed, and now other grasses and white clover are appearing; it is in marked contrast to the portion left untreated.

> **"This would lead up to the idea that, in the place of the usual routine here—roots, grain, grass, or vice versa, then after a few years in grass the process repeated—the grassland should be laid down with the land in the best condition and, having sown down this grass, conserve it with judicious topdressing. This appears so important and interesting that it is proposed with the co-operation of some agricultural associations to undertake a careful trial of topdressing."**

After the early trials the Department of Agriculture expected that the practice would be rapidly adopted, as the following extract from the Department's 1906 report indicates: "The topdressing of grassland was strongly urged in the last report, but so far as can be learned little or nothing has been done. . . . "

Improvements in general farm practice are, however, only slowly adopted, and more than 50 years after the first pioneers demonstrated the efficacy of phosphatic topdressing in the Waikato the practice is not yet fully exploited in the Dominion. Imports of fertilisers rose very slowly, and it was not until the 1912-21 period that topdressing became recognised as a sound farm practice, and the increased demand for fertilisers was largely due to rising prices for butterfat. Table II shows the total fertiliser imports at five-yearly intervals between 1901 and 1921.

TABLE II—FERTILISER IMPORTS

Year.	Fertiliser Imports (Tons)
1901	33,726
1906	57,555
1911	86.467
1916	101,157
1921	82,484

Fertiliser importations declined greatly during the later years of the First World War, but rose again rapidly after 1921, when supplies of rock phosphate were obtained from Nauru. Early topdressing fertilisers were either basic slag or a mixture (Waikato) of equal parts superphosphate, bonedust, and phosphatic guanos, and the main topdressing districts were the Waikato and Taranaki.

Before 1914 the classes of the main phosphatic fertilisers imported were not separately enumerated, but in that year the importations were as follows:

	Tons.
Basic slag	36,600
Blood and bone	1,200
Bonedust	9,000
Rock phosphates	20,700
Superphosphate	56,100

Not all these phosphatic fertilisers were used for topdressing, a portion of them being required for turnips, of which nearly half a million acres were sown in 1914. Still sufficient were used for topdressing to establish the practice, and Clifton on his retirement from the Department continued his advocacy of topdressing. For many years he was associated with the editorship of the "Farmer Weekly" magazine and in its pages he continued to work for better grassland farming. He lived to see the magic of topdressing used to begin to turn the sterile clays and pumice sands of the Auckland district into swards of perennial ryegrass and white clover, and to see the Fields Division, of which he was the first director, take a leading part in the development of intensive grassland farming.

Surface-sown Grasslands

"The Settler's Handbook of New Zealand" (1902) sets out the grass mixtures recommended for surface sowing in the various Land Districts at rates varying from 20lb. to 30lb. per acre. The mixture generally recommended was somewhat as follows:—

	lb. per acre.
Cocksfoot	5
Perennial ryegrass	10
Italian ryegrass	3
Crested dogstail	1
Meadow foxtail	2
Timothy	2
White clover	1
Cowgrass	1
	25
Rape	2
Total per acre	27

On land not of the best quality farmers were advised to increase the cocksfoot, decrease perennial ryegrass, omit foxtail and timothy, and add 1lb. of chewings fescue, ½lb. of danthonia, 1 to 2lb. of *Poa pratensis*, ½lb. of *Lotus corniculatus*, and 1lb. of *Lotus major*. Commenting on the Auckland bush lands the handbook states, "It is unfortunately a fact that a great deal of these bush lands will not hold the grasses usually sown for more than three years, with the result that owing to the stumps and top-cumbering, the ground cannot be ploughed for several years, until these either decay or the land is stumped. In the meantime (with the exception of the hardier grasses) weeds and rubbish take possession of the land and carrying capacity is reduced to a minimum. **This difficulty should in a great measure be met by sowing a judicious mixture of grasses when the land is first laid down, and it is a matter that requires more attention than it receives."**

Further difficulties were encountered as settlement was pushed into the highly-elevated and heavy-rainfall areas, for the handbook goes on to state, "There are tracts of high range bush lands as [Te] Rauamoa in Kawhia County, high range country in Hokianga, and high forest lands in Rotorua County. Here experience has shown that good results are obtained by letting the felled bush lie for an extra season, then underscrubbing any fresh growth, together with close lopping. These high forest lands are subject to heavy rainfall. The bush lands have a heavy cover of decayed foliage and mossy growth; this holds the wet like a sponge, and does not dry sufficiently in one season to ensure good burns. The grass seed when sown apparently takes well, but with the summer heat the deposit burns up and the roots of the grass, not having reached the solid earth, die out, with the sequence that another burning and sowing is essential. . . . "

Although the bush burn sowings usually gave a high carrying capacity during the first year, this production was not maintained, and the large area converted to pasture during the first two decades of the century did not raise North Island carrying capacity greatly measured by present standards. The impression that the surface-sown grasslands in general once carried much larger flocks of sheep and herds of cattle than they do at present is wrong. This is made clear in Table III.

TABLE III—AREA UNDER PASTURE AND NUMBER OF SHEEP AND CATTLE IN NORTH ISLAND 1901-1921.

Year.	Area under grass. millions of acres.	Total Sheep. millions.	Total Cattle. millions.
1901	7.1	10.2	.9
1906	7.7	10.0	1.4
1911	9.1	12.8	1.6
1916	10.1	13.8	1.9
1921	11.1	12.8	2.5
(1946	12.4	18.0	4.0)

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TUSSOCK GRASSLANDS AND ANNUAL CROPS . . .

Between 1901 and 1921, though sown grass increased by 4 million acres, total sheep increased only by 2.6 million and cattle by 1.6 million, whereas in the 1921-46 period, though sown grass increased by only 1.3 million acres, total sheep increased by 5.2 million and total cattle by 1.5 million.

A. H. Cockayne, who was appointed the Department of Agriculture's Biologist in 1909, in addition to organising the general work of the Biology Section of the Department, interested himself during the 1910-21 period in the problems of pasture establishment and management, and his writings clarify the problems and practices of grassland farmers during this period. He emphasised the necessity for permanence in surface sowings, stating, "In fact, the whole object of surface sowing is the production of a pasture that will permanently produce a good yield of herbage suitable for grazing stock. Unfortunately a good proportion of our bush burn pastures on inferior ground yield heavily for the first few years after sowing and then seriously deteriorate in carrying capacity. In many cases this is due to the use of too large a proportion of short-lived grasses, whose place is afterwards taken by plants that are suited to the conditions but are not of any value from a pasture point of view. . . . Many surface-sown pastures on land unsuited to ryegrass have seriously deteriorated in carrying capacity after the first few years through the mixture being mainly composed of this grass. There is a very prevalent opinion that ryegrass seed harvested in the North Island, especially that from Hawke's Bay and Poverty Bay, is more permanent in character than seed saved in the South Island . . . there seems little doubt that seed from old-established pastures is more permanent than seed harvested from alternate - cropping land. . . . "

He stressed the importance of the inclusion of crested dogstail and danthonia in surface-sown mixtures, drew attention to the use of browntop, *Lotus major*, and *Lotus hispidus*, and emphasised the folly of sowing anything but the best seed and the fact that poor land required a much more expensive seed mixture than good land.

Even with the authoritative recognition of the need for the inclusion of low fertility demanding grasses in bush burn mixtures, the average settler continued to sow mainly ryegrass, cocksfoot, and clovers along with rape and turnips. Much of the ryegrass used was false perennial, which rapidly disappeared, and quite large areas were sown with cheap bush burn mixtures consisting largely of worthless seed. In the lower and moderate-rainfall areas the unobtrusive invasion of danthonia saved the pastures, but in the high-rainfall areas secondary growth quickly invaded unsatisfactory pastures.

Tussock Grasslands

The tussock grasslands of the South Island, on which the early prosperity of the pastoral industry had been based, gave signs in places of serious deterioration in carrying capacity, while large areas of the lowland tussock areas were being transformed into danthonia pastures and carried more sheep than formerly.

The problem of deterioration and depletion of the South Island tussock grasslands was first officially discussed by Clifton in the Department's annual report for 1909 as follows: "Over a great part of Otago the most marked feature is the denudation of the country. It is told on all sides that when stock first occupied that district native grasses grew with luxuriance; that grass was cut for hay on the hillsides where now nothing remains but the bare soil and shingle boulders. The agents of this denudation are given by long-resident farmers and pastoralists as, in the first instance, fires at all seasons whenever the grass would burn, followed by overstocking, intensified by the advent of the rabbit. For years this deterioration process has gone on, and it is still proceeding. . . . The importance of this subject cannot well be over-estimated. The denudation of the soil applies to an enormous area of country throughout the pastoral districts of the South Island, and more particularly to the lands generally described as the waste lands of the Crown and held under grazing-leases. **The chief proposal is that grazing should not be continuous on such lands, that on each run a portion should be left unstocked to permit the natural grasses to recover and reseed, and that on lands where denudation is apparently complete an attempt should be made to reseed with certain selected grasses. . . . "**

Deterioration and depletion of the tussock grasslands has been under close study since Clifton made the above report. Dr. Leonard Cockayne made an exhaustive study of the problem in the early 1920's and again emphasised the necessity for spelling and natural rejuvenation, but the cost of fencing in relation to the returns from the land has so far precluded any general action in this direction.

Annual Crops

Annual crop production was an important feature of farming on ploughable land in both islands in 1900. In the North Island worn-out pastures were ploughed, sown in swedes or other root or fodder crops, and then with spring-sown oats, barley, or wheat. In the South Island arable farming followed much the same lines as it does today, the land being under crop for three to four years and then in pasture for a similar period. In 1900 the total area under annual crops was 1½ million acres; wheat (270,000 acres) and oats (398,000 acres for threshing and 176,000 acres for chaff) were the important cereals, and turnips (415,000 acres) and rape (125,000 acres) were the major fodder crops.

The 1900-1920 period covers the gradual decline in the country's export trade in wheat. Only in three seasons after 1922 have net exports of wheat exceeded imports; these were 1922-23, 1923-24, and 1933-34, when depression conditions in the sheep industry caused an increase in wheat acreage. In 1900 the country grew 34.6 acres of wheat per 100 of population and in 1920 this had dropped to 12 acres per 100, when the area grown was 139,611 acres. The comments in the 1920 annual report of the Department of Agriculture might quite well be repeated in 1947: "The reasons both national and economic for New Zealand maintaining its wheat production at least sufficiently to supply local requirements have been further strengthened by the recent course of events. Australia has demonstrated its unreliability as a source of supply and shipping facilities in these waters have failed to keep up with the demand for tonnage, while the outside world price for wheat has risen to a level almost prohibitive judged on standards of this country. A total area of 300,000 acres of wheat at normal average yield is sufficient for the Dominion's present consumption. . . . "

The immediate cause of declining wheat acreage in the early 1900's was the fall in prices, which dropped from 4/6d. a bushel in 1899 to 2/10d. in 1900 and 2/8d. in 1901. Subsequent recoveries in price caused increased areas to be sown during the first decade of the century, but the increasing returns from lamb production caused the wheat area gradually to decline. Some recovery was made during the First World War, but with the increasing population and with unparalleled advantages in lamb production the country after the First World War was an importer instead of an exporter of wheat.

The wheat varieties sown remained practically unchanged from 1860 to 1921, Tuscan, Hunters, and Pearl being the chief wheats grown. During the 1900-1910 period commercial seed became very mixed in purity, and in 1910 Dr. F. W. Hilgendorf, Canterbury Agricultural College, Lincoln, began the selection of pure lines of common varieties and put them out to commerce as College Hunters, College Tuscan, etc. He started cross-breeding in 1921 and his pioneer work in wheat improvement has since been carried on by the Wheat Research Institute.

Oat production for threshing also declined during the 1900-1921 period. Whereas wheat prices slumped in the

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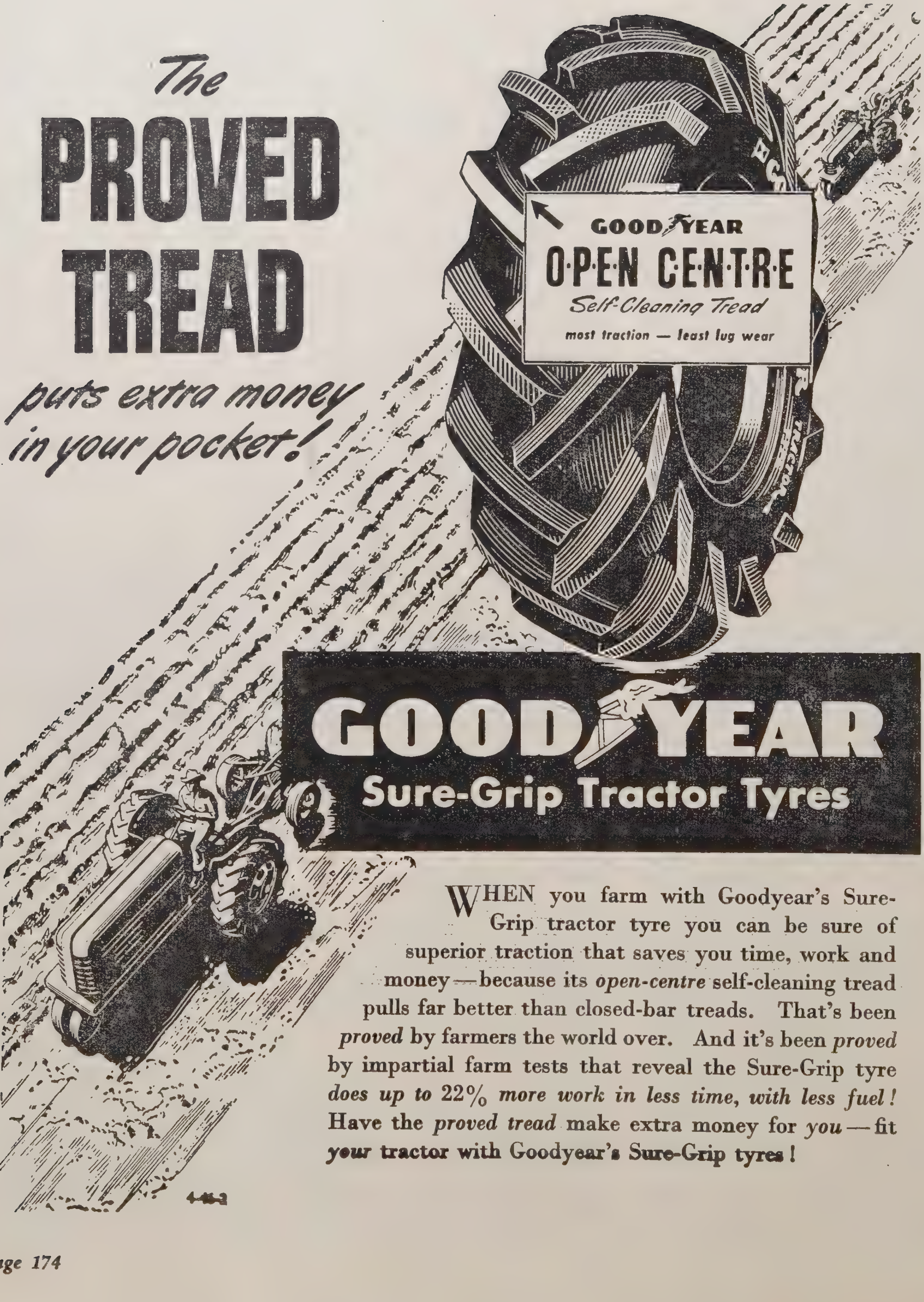
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early 1900's, oat prices were good because of the export trade induced by the South African War, and oats for threshing rose from 398,000 acres in 1900 to 483,000 acres in 1903. The area then declined with seasonal fluctuations to 179,000 acres in 1920. Throughout the period, however, oats for threshing and chaff remained at approximately 500,000 acres, for the country was still dependent on the horse for farm work and general transport.

Oat rust was a serious problem in the wetter districts and Algerians were the common variety grown. So serious was the rust problem in the Auckland district that one of the first activities of the Ruakura Experimental Farm was the selection of a rust-resistant oat. Mr. A. W. Green selected the Ruakura rust-resistant oat, which, although it obtained certain popularity overseas, was little used in Auckland, where oat growing rapidly declined as the adoption of topdressing made it no longer necessary to renew pastures regularly on ploughable land.

The development of the trade in frozen mutton and lamb had already made it necessary in 1900 to produce half a million acres of root and green fodder crops. These were also necessary on dairy farms, where root feeding in winter, late summer, and autumn was common practice. The area under turnips and swedes rose with seasonal fluctuations from 415,467 acres in 1900 to 572,137 acres in 1916 and fell to 542,310 acres in 1920. The area in rape and other green fodder crops also rose fairly steadily up to 1916, from 125,367 acres in 1900 to 229,445 acres in 1916, and then declined to 166,758 acres in 1920.

During the second decade of the century the Department of Agriculture was engaged in the improvement of fodder crop production, realising that adequate fodder crops were essential for both meat and milk production and that only with high yields could fodder crops pay for the cost of production. New fodder crops were introduced, some of which, such as Japanese millet, received temporary popularity. Variety and manurial trials were carried out and the Department gave a good deal of attention to the development of silage production from annual crops such as oats and vetches, sorghums and maize, but the production of silage from annual crops never became popular. If fodder crops had to be grown in a country with a high rainfall roots were the obvious crop. Silage making did not become at all popular until topdressing produced such a surplus of early summer grass that only by ensiling it could growth be controlled and the feeding value of the pastures maintained.

Potatoes were cultivated in all parts of the country in 1900 and were a cash crop that the small farmer often relied on. "The Settler's Handbook" for 1902 states, "Potatoes are largely grown throughout New Zealand. On suitable soils very heavy crops are raised, it being no uncommon thing to dig from 8 to 10 tons per acre, although the general average is much lower for the reason that unsuitable land is often devoted to this crop. . . . The year 1898 will long be remembered as a record one for potato growers as regards prices. The drought which affected several of the Australian colonies caused a great shortage in that esculent and prices advanced to £6 to £7 per ton. . . . " In 1900 there were 36,984 acres in potatoes, but in 1905 late blight made havoc of the potato crops in the wetter districts. Writing in 1906 of the Auckland district Clifton states, "The potato blight has not spared this district. . . . Spraying has been largely availed of; its value is no doubt admitted and realised, still our growers have not been so successful in combating the scourge as anticipated. . . . Potato culture in this colony has entered on a new phase: it is no longer possible to take potatoes out of a pit, heap, or sack, plough them in on a piece of ill-prepared land, and harvest a bounteous yield. . . . The potato blight is everywhere. . . . " Potato growing rapidly declined in the wetter districts, except for the special production of early potatoes, the high price for which allowed a margin after the cost of the necessary spraying. Main crop potato growing became concentrated in the lower-rainfall, arable districts where spraying is not normally necessary.

[*Green and Hahn Ltd. photo.*

Dr. F. W. Hilgendorf

Meat and Wool

From 1901 the North Island gradually gained ascendancy in the meat and wool industries as the pastoral area was increased through the felling and grassing of the vast forested areas of the western central districts.

The developments in the sheep industry in the 1901-21 period are summarised in Table IV.

Sheep farming development was influenced by the First World War. The decline in ewes and total sheep between 1916 and 1921 was due to several causes, the chief being heavy killings in the late war and early post-war years, deterioration of North Island pastoral lands through reversion, and the rise of the dairy industry.

Apart from the gradual expansion in sheep numbers, which was mainly due to the increase in number of breeding ewes, the main change in the sheep industry was in breeding practice to suit the demands for mutton and lamb and to provide suitable sheep for the expanding North Island pastoral area. The changes in breeding practices are summarised in Table V.

In the North Island the change in general breeding was from the Lincoln to the Romney. In the early days of farming surface-sown country covered with freshly-burnt logs and stumps, the Romney wool tore easily on the sticks and collected a great deal of charcoal. To overcome this the Romney-Lincoln cross was evolved, which produced a fleece better able to withstand the hard conditions and a sheep with a better constitution for rough conditions than the pure Lincoln. This cross was maintained at a certain level of uniformity by mating each year the coarse-woolled ewes with Romney rams and the finer-woolled ewes with Lincoln rams. With the passing of rough conditions on hill-country farms, the Romney-Lincoln cross was rapidly disappearing in 1921. For specialised fat lamb production in the North Island English

TABLE IV—BREEDING EWES AND TOTAL SHEEP, NORTH AND SOUTH ISLANDS, 1901 TO 1921

('000's omitted)

	Breeding Ewes.			Total Sheep.		
Year.	N.I.	S.I.	Total.	N.I.	S.I.	Total.
1901	4,838	5,068	9,906	10,219	10,014	20,233
1906	5,114	5,365	10,479	10,009	10,099	20,108
1911	6,355	5,970	12,325	12,814	11,182	23.996
1916	7,230	5,662	12,892	13,881	10.907	24,788
1921	6,312	5,835	12,147	12,774	10,511	23,285

and Border Leicester and Shropshire rams were replaced by Southdowns.

TABLE V—BREEDS AS A PERCENTAGE OF TOTAL RAMS, NORTH AND SOUTH ISLANDS, 1901 to 1921.

Breed.	North Island. 1901. %	North Island. 1921. %	South Island. 1901. %	South Island. 1921. %
Merino ..	4.59	0.59	24.05	7.96
Lincoln ..	62.16	13.62	9.68	1.74
Romney ..	19.59	73.78	11.77	30.86
Border Leicester	2.39	1.04	17.52	16.50
English Leicester	5.38	0.74	21.94	16.41
Shropshire ..	2.16	0.42	7.20	1.51
Southdown ..	1.56	9.03	1.35	1.50
Corriedale, halfbred, and others	2.17	0.78	6.49	23.52

The chief change in the South Island during the 1901-1921 period was the decline in the Merino and the rise in the Romney, the Corriedale, and the halfbred. Specialised breeding for fat lamb production remained centred in the English and Border Leicesters.

During the 1900-1914 period lamb production assumed increasing importance, but this trend was interrupted by the food demands of the First World War and the shipping difficulties and price factors induced by the war. The relative importance of lamb and mutton exports during the 1901-21 period is shown in Table VI.

TABLE VI—EXPORTS OF LAMB AND MUTTON, 1901 to 1921

Year.	Lamb. cwt.	Mutton. cwt.
1901	513,187	985,945
1906	756,234	918,770
1911	1,020,049	869,194
1916	966,438	1,276,237
1917	470,080	1,044,603
1918	418,823	827,385
1919	1,049,416	1,894,275
1920	1,354,514	2,436,917
1921	1,254,373	2,102,292

Wool exports rose in conformity with the gradual increase in sheep numbers, but the even flow of exports was somewhat interrupted during the later years of the First World War. Changes in type of wool were a reflection of changes in breeding practices. In the South Island the use of Merino rams declined and the Romney, Corriedale, and halfbred increased, while in the North Island the Lincoln declined and the Romney increased; hence the proportion of halfbred, superfine, and fine crossbred wool increased and the low crossbred decreased.

Radio Broadcasts

RADIO talks to farmers will be given from Station 1YA Auckland at 7.15 p.m. on the following dates.—

September 1—"Current Farming Problems," by J. E. Davies and G. L. Banfield, Instructors in Agriculture.

September 8—Veterinary talk, by J. C. Gerring, Veterinarian, Hamilton.

September 15—"Development of Peat Land," by G. L. Banfield, Instructor in Agriculture, Thames.

September 22—Young Farmers' Club session, by a representative of the Waikato Y.F.C. district committee.

September 29—"Hill-country Pasture Problems," by P. W. Smallfield, Director of the Rural Development Division, Wellington.

The development of the export trade in frozen beef and the general recognition that surface-sown grazing country required a definite proportion of cattle to sheep for pasture control and maintenance were important features of pastoral development during the 1900-1920 period. The general features of the rise in cattle numbers between 1901 and 1921 are shown in Table VII.

TABLE VII — DAIRY COWS AND TOTAL CATTLE, 1901 to 1921.

Year.	Total Dairy Cows.	Total Cattle.
1901	406,606	1,256,680
1906	574,794	1,810,936
1911	633,733	2,020,171
1916	750,323	2,417,491
1921	1,004,666	3,139,223

With the extension of settlement into the higher-rainfall areas of the North Island it became necessary to develop cattle grazing as an integral part of sheep farming to cope with the natural tendency of newly-grassed forest lands to revert to fern, and Table VII shows that while dairy cows increased by 600,000 between 1901 and 1921, total cattle increased by nearly 1,900,000. It became recognised that the maintenance of surface-sown hill-country pastures required that cattle and sheep should be grazed in the proportion of about 1 cattle beast to 10 sheep; a higher proportion of sheep to cattle sufficed in the lower-rainfall areas, but a slightly lower proportion of sheep to cattle was requried in the higher-rainfall areas.

Early maturity was not aimed at with beef cattle maintained on surface-sown hill-country farms for pasture control, as young cattle from 1½ to 2½ years old are most satisfactory for cleaning up rank growth and crushing out undesirable vegetation in the summer and autumn. In 1900 the majority of beef cattle were Shorthorns, but in 1921 Herefords and Aberdeen Angus almost equalled Shorthorns in importance, as they were found more suitable for hill-country pasture control. Data on breeds of beef cattle are available for 1918 and 1921 and the changes in breeding practices between those years (and for 1928) are shown in Table VIII.

TABLE VIII—NUMBERS OF PURE-BRED AND CROSSBRED BEEF CATTLE.

Breed.	1918.	1921.	1928.
Shorthorn—			
Purebred ..	N.A.	8,585	2,630
Crossbred ..	N.A.	810,666	417,493
Hereford—			
Purebred ..	4,993	5,221	4,210
Crossbred ..	289,462	439,533	426,241
Aberdeen Angus—			
Purebred ..	2,105	3,583	4,269
Crossbred	145,178	200,144	351,118
Others—			
Purebred ..	119	23	116
Crossbred ..	49,789	17,094	8,285

Aberdeen Angus and Herefords, which have continued to increase in popularity, are now the chief breeds of beef cattle on pastoral country, and their wider use has resulted in better pasture control and provided suitable stock for the development of the chilled beef trade which began to assume importance in the early 1930's.

Pig meat production between 1901 and 1921 was mainly confined to local supply and the market for export frozen pork was not fully exploited. The exports of pig meat between 1901 and 1921 are shown in Table IX.

TABLE IX—EXPORTS OF PIG MEAT.

Year.	Quantity. cwt.
1901	9,765
1906	6,475
1911	11,958
1916	8,803
1921	5,695

The period closed in an air of uncertainty; signs of falling prices were apparent and meat was the first to suffer. During the First World War the Imperial Government had developed the bulk purchase of the Dominion's exportable surplus of primary products. The drastic fall in prices in 1921 coincided with and probably hastened de-control and the meat industry was faced with a grave crisis, not only in marketing but in the deterioration of much hill-country pastoral farming land. Land speculation and neglect of maintenance due to shortage of labour and materials during the First World War added to the burdens of the pastoralist faced with falling prices. From this crisis emerged the development of control boards charged with the marketing of produce (the Meat Board was established in 1922) and recognition by the Deteriorated Land Act, 1925, that hill-country pastoralists on difficult land required assistance.

Continuation in the September Issue of the "Journal"

The concluding section of this article reviewing the development of farming during the first two decades of the 20th century will appear in the September issue of the "Journal." It will deal with the development of the dairy industry, the control of animal and plant diseases and pests, and the grading of produce.

Acknowledgment is made to the Lands Department and the Railways Department for reproductions of photographs in this article.

Effect of Sowing Method on Yield of Linen Flax

IN 1944, 1945, and 1946 the Fields Division of the Department of Agriculture conducted trials in South Canterbury to determine the influence of the Holland coulter as against 7in. drilling on the yield of the linen flax crop. The straw harvested from these trials was then processed by the Agronomy Division of the Department of Scientific and Industrial Research to ascertain what influence the two methods of sowing might have on fibre content. In this article J. W. Hadfield, general manager of the Linen Flax Corporation, summarises the results and draws from them conclusions that should have a bearing on flax production in the future.

IT has long been recognised in theory that if plants could be spaced evenly over the surface of a field, the yield would be greater than could be obtained were the same quantity of seed to be sown in drills of, say, 7in. spacing; moreover, individual plants growing evenly spaced would be more uniform than those growing in drills, where the space for individual development would be more cramped.

Probably no crop responds more readily to uniformity of seeding than linen flax, because uniformity increases not only yield to the acre but also the yield of fibre from a given weight of crop. As the flax crop is bought by weight, and as the price is decided by its fibre content, uniformity of seeding becomes doubly important.

The Holland coulter has been designed for attachment to the ordinary 7in. drill to bring this principle into practice. In operation it has the effect of broadcasting the seed beneath the surface of the soil to any reasonable depth required, and that ensures an evenness of germination not possible when seed is broadcast on the surface and harrowed in.

Trials of the Holland coulter were undertaken by the Fields Division in South Canterbury in 1944, 1945, and 1946, but this report covers only the first two years, because in the third year serious damage by birds while the seed was germinating prevented any measure of reliability. The trials were designed to make direct comparisons between the use of the Holland coulter and normal 7in. drilling at different rates of seeding, and were replicated eight times in each year to overcome soil variation.

Table I shows the yields obtained in the field at various rates of seeding. The yield from the areas on which the Holland coulter was used was nearly always higher than that from the areas on which the seed was sown by the normal method in 7in. drills.

It has been demonstrated in the past that the yield of flax will increase steadily as the rate of seeding increases up to a certain limit, decided no doubt by soil and rainfall. That is shown to be so in Table I, and it is also interesting that when the Holland coulter is used the optimum is higher than in the case of 7in. drilling. In effect that means that it is safe to sow more heavily with the Holland coulter than in 7in. drills and that a resultant increase in yield may be expected. Moreover, the Holland coulter plots were less inclined to lodge, and the even distribution of the plants helped materially in checking weed growth.

Distributing seed evenly has the effect of making the straw more uniform by largely eliminating the weak, spindly plants usually seen growing in the crowded 7in. drills. Other factors may also play a part, but even sowing not only increases the tonnage an acre but increases the extractable fibre content of that straw.

The yield of fibre an acre may then be determined, and that is the important figure because the grower is paid on the yield and quality of the fibre. These yields are recorded in Table II, which with one exception shows an advantage to the Holland coulter.

TABLE I—YIELD OF CROP IN TONS AN ACRE

Year	Type of coulter	Rates of seeding (lb. an acre) 125	115	90	60	Mean
1944-45	Holland coulter	2.45	2.54	2.09	2.11	2.30
	7in. drills	2.21	2.35	2.21	1.96	2.18
1945-46	Holland coulter	2.37	2.34	2.14	1.95	2.20
	7in. drills	2.06	2.11	2.01	1.80	2.00

TABLE II—YIELD OF FIBRE IN POUNDS AN ACRE

Year	Type of coulter	Rates of seeding (lb. an acre) 125	115	90	60	Mean
1944-45	Holland coulter	704	677	526	445	588
	7in. drills	569	611	536	427	536
1945-46	Holland coulter	415	374	321	298	352
	7in. drills	307	303	303	244	289

The results shown in Tables I and II appear more intelligible when they are brought down to a cash basis. For that purpose it is reasonable to make comparisons in each season between the best rate of seeding for each type of coulter and regard all fibre as being an average grade C. The position would then be as follows:—

SEASON 1944-45

The best rate of seeding with the Holland coulter was 125lb., and 115lb. was the best rate sown in 7in. drills.

Holland coulter treatment yielded 13 per cent. of fibre—crop value £12 13s. 3d. a ton.

Seven-inch drilled treatment yielded 11.8 per cent. of fibre—crop value £11 4s. 6d. a ton.

Advantage to Holland coulter—£1 8s. 9d. a ton.

Holland coulter treatment yielded 2.45 tons of crop an acre at £12 13s. 3d. a ton—£31 0s. 5d. an acre.

Seven-inch drilled treatment yielded 2.35 tons of crop an acre at £11 4s. 6d. a ton—£26 7s. 7d. an acre.

Advantage to Holland coulter—£4 12s. 10d. an acre.

SEASON 1945-46

In this season 125lb. of seed an acre proved to be the best for both types of drill in yield of fibre an acre.

Holland coulter treatment yielded 7.9 per cent. of fibre—crop value £6 8s. 3d. a ton.

Seven-inch drilled treatment yielded 6.7 per cent. of fibre—crop value £5 2s. 9d. a ton.

Advantage to Holland coulter—£1 5s. 6d. a ton.

Holland coulter treatment yielded 2.37 tons of crop an acre at £6 8s. 3d. a ton—£15 3s. 11d. an acre.

Seven-inch drilled treatment yielded 2.06 tons of crop an acre at £5 2s. 9d. a ton—£10 11s. 8d. an acre.

Advantage to Holland coulter—£4 12s. 3d. an acre.

The returns an acre quoted would be subject to deductions for seed supplied and for harvesting and carting when those operations are undertaken by the factory.

From the results of those trials there would appear to be a very good case for the use of the Holland coulter in the sowing of linen flax to ensure even distribution of seed. A set of these coulters will be available at each flax factory for those who care to use them for the sowing of the linen flax crop this year.

FARM WORK FOR SEPTEMBER

By the Fields Division.

PASTURES

Harrow pastures to spread animal droppings; that will be particularly necessary where hay and roots have been fed out to stock. When conditions are suitable roll pastures which have been badly poached. Paddocks affected by grass-grub may also be rolled to encourage rerooting. Close fields for hay and silage, those intended for silage first. Cutting for hay or silage tends to weaken the bottom of the sward, but that effect can be minimised by closing fields early and harvesting the crops early rather than late. Graze areas intended for grass seed or white clover seed production evenly but not too severely.

If growth is inclined to lack vigour, and if supplies are still available, fields intended for hay or silage should receive an application of fertiliser. Sow from 1 to 2cwt. of superphosphate or ammoniated superphosphate an acre, the larger quantity in the higher rainfall areas. Fields to be closed for ryegrass seed production may benefit from an application of 1cwt. of sulphate of ammonia an acre if the growth has an unhealthy appearance. Cocksfoot seed producing areas may also respond to a similar topdressing applied now. Lucerne stands should receive their annual application of phosphate if that has not been done already.

SUPPLEMENTARY FEED CROPS

In some districts crops such as maize, millet, cattle pumpkins, mangolds, and swedes are sown in October. Such land should receive an occasional stroke with the grubber or disc harrows during this month. Early breaking down of the furrow is desirable; do not leave all the cultivation until just before sowing the crop. If the work has not been done already, the land for rape, turnips, and chou moellier should be ploughed.

WHEAT

Continue with sowings of spring wheat on good land. Sowing wheat on light land in the spring entails too much risk of a failure. Sow Cross 7, Fife Tuscan, Jumbuck, Marquis, or Tainui—whichever variety has been found most suitable for the locality. Tainui is an early-maturing wheat particularly suited to spring sowing on some of the wheat-growing areas of the North Island. Sow ¼ to ½ bushel more seed an acre than is usual with autumn sowings. A seed-bed much finer than is customary for autumn-sown wheat is desirable.

Harrow and roll autumn-sown wheat. If the ground is loose, only rolling may be necessary, but if the ground is very consolidated, use a penetrating harrow or a drill with the coulters down to obtain a mulch. While rolling and harrowing are in progress sow grass and clover seed if it is intended to sow down in the crop. Where growth of wheat is particularly forward it may be grazed. Use a large mob of sheep to feed the growth off evenly and quickly.

BARLEY AND PEAS

Sow malting barley on a well-worked seed-bed at the rate of 1½ to 2 bushels an acre. Chevallier, Plumage-Archer, Spratt-Archer, and Goldthorpe-Spratt are the common varieties grown, but Research has found favour as a variety suitable for direct heading. Even drilling is necessary to obtain a good sample of malting barley.

If the weather permits suitable cultivation of the ground, sow peas throughout the month. Partridge and Prussian Blues, Mammoth Blues, or any of the garden varieties of peas may be sown now. Heavy seedings usually give the best results; sow not less than 3½ bushels an acre of Partridge peas, and with garden peas or Mammoth Blues at least 4 bushels an acre is desirable. Apply lime before sowing in districts where peas are known to respond to lime.

LINSEED AND LINEN FLAX

Land for linseed and linen flax should have been ploughed during the winter. Continue with cultivation to arrest weed growth, and also to prepare a seed-bed for sowing later in the month or in October, depending on the weather. Sow linseed at 35 to 40lb. an acre and linen flax at about double that quantity; 1cwt. of superphosphate an acre should be drilled with the seed.

POTATOES

Where there is little risk of frost damage some of the earlier varieties of potatoes, such as Arran Banner, Aucklander Short Top, Arran Pilot, Jersey Bennes, Black Kidney, and Epicure, may be planted. Prepare the ground for planting main crops in October. Sort over seed potatoes and store them under conditions suitable for the development of strong, healthy sprouts.

IRRIGATION

With the approach of summer, irrigation farmers should prepare for the busy season ahead of them. Races, banks, junctions, and head-gates should be inspected to see that they will allow a good volume of water without causing damage and consequent loss of head. Lack of consolidation of soil round head-gates allows the water to percolate round the structure, and under pressure the whole structure may be washed out and become a source of trouble throughout the season. Canvas dams used to divert the water on to the land should be inspected.

STOCK

In most districts September is an exceptionally busy month for stock work. Lambing and calving are in full swing.

Sheep.—The shepherd should almost live with his flock during this time. A good lambing dog is essential and one that sets his sheep is preferable. A long stick with a crook at one end is required, and raddle and twine should always be carried. Small mothering pens should be built in sheltered places in the lambing paddocks. Though most farmers have their own ways of organising their lambing programme, a practice followed by some with a flock of up to 500 ewes is to begin lambing with the whole flock in one paddock. After two days the ewes are moved into the next paddock, leaving behind ewes with lambs. That is repeated every two or three days until the available paddocks are exhausted or the flock to lamb is small enough to be held in one paddock. That method has the advantage that all the lambs of the same age are together, and they can be tailed when ready. Tailing yards should be erected on some clean spot. In the earlier districts, where lambing and tailing have been completed, barren ewes and those with deformed udders should be marked for the fattening pens and disposed of as soon as possible. In some districts preparation for the dry shearing should be under way.

Cattle.—In the early districts, where calves are some weeks old, they will be on to skim-milk. Some concentrates should be fed with the milk. Feeding buckets should be kept thoroughly clean and sterilised at least once a week. Constant watch must be kept for signs of unthriftiness caused by indigestion and scouring. In districts where cows are just coming in, heavy-conditioned cows, which are prone to milk fever, should be given scanty rations for a week or so before calving and a molasses drench directly after calving.

Pigs.—With the milking season well under way, skim-milk will be the pigs' main diet. A warm, well-ventilated shelter should be provided, with frequent changes of bedding straw. Pigs should be given cod liver oil occasionally, as well as having access to greenfeed. Charcoal in some form should be readily available, and lime should also be accessible in shallow troughs.

The Story of a Raspberry Variety

A MOST interesting story has recently been unfolded in connection with the Lloyd George variety of raspberry. The story, recounted in this article by J. P. Hudson, Horticulturist, Wellington, describes yet another way in which New Zealand and Britain may be able to help each other.

WHEN the Lloyd George raspberry was introduced to commerce about 1920 it took the British raspberry industry by storm because of its vigour, quality, and apparent freedom from troubles. It became regarded as the finest commercial variety in cultivation and was more widely planted than any other, but within 10 years it had developed a virus disease which caused it to lose vigour, crop poorly, and become almost useless as a commercial variety.

As a rule the virus did not cause plants to die completely—in fact, it would have been better for growers if it had, as then they would at least have known where they were. Instead, the degeneration set in slowly and gradually permeated all commercial stocks. All young canes from infected plants were themselves infected, though they often looked healthy and were used for planting new areas. The new areas sometimes showed promise for a season or two while the canes responded temporarily to the high fertility of new soil, but within a year or two the plantations ceased to bear paying crops and had to be ploughed in.

Disappearance of Varieties

This increasing susceptibility to virus is the first step in the decline and disappearance of a variety and is, no doubt, the reason who so many of the older raspberries are no longer in cultivation.

The decline and final disappearance of a variety is, however, a long and very costly and inconvenient business. With their usual optimism, growers will persist in trying the variety just once again—"giving it another go." The number of disappointments, half or quarter crops, and heartaches that a variety causes before it is finally discarded cannot be assessed, but it must be very considerable.

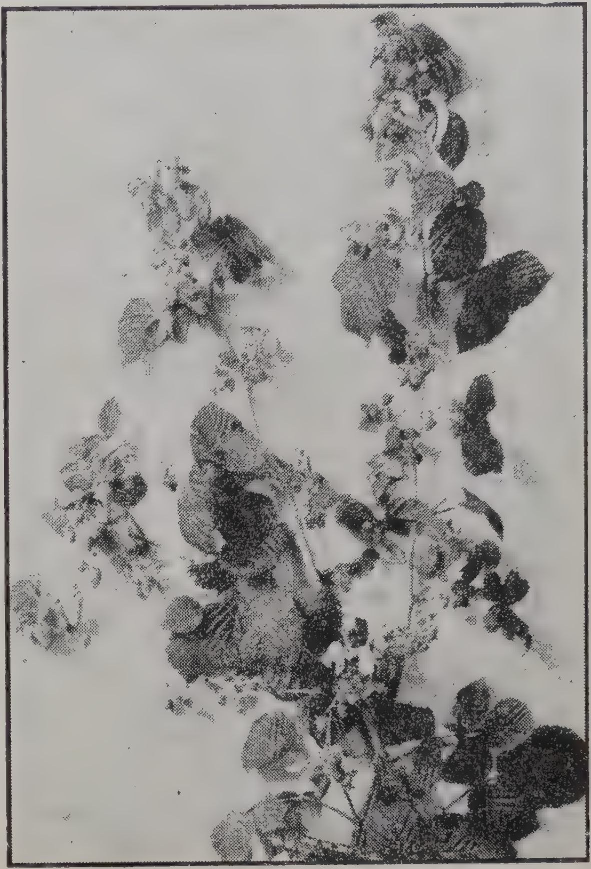
"Mosaic-free" Lloyd George

A gallant attempt to resuscitate the Lloyd George raspberry was made by the workers of the East Malling Research Station in England. They selected a few apparently-healthy canes of the variety after long and patient search. These were propagated under conditions of isolation, kept under constant examination, and eventually built up into a large stock of plants which were certainly more vigorous and healthy than other available stocks.

The East Malling "Mosaic-free Lloyd George" canes have been widely planted and in many cases have enabled growers again to produce payable crops of raspberries. However, recent tests have shown that even these stocks are totally infected with virus, though of a type which so far seems relatively innocuous.

Nelson Lloyd George

In 1945 a delegation of representatives of the British National Farmers' Unions spent a few weeks in New Zealand as part of a world tour. Mr. Giles Tuker, one of the members of the delegation and a well-known English grower with more than 100 acres of orchards in Essex, was astonished at the vigour of some of the raspberry plants he saw, especially of the variety Lloyd George growing in Nelson Province. Research workers at East Malling Research Station, who had been investigating the virus diseases of raspberries, were intrigued by Mr. Tuker's account of the Nelson Lloyd George, which still seemed to have the vigour which raspberries of this variety in Britain had lost.



Lloyd George raspberries.

Dr. Hatton, director of the research station, therefore wrote to inquire whether canes of Nelson Lloyd George could be sent to England, and that was done, the canes being made available through the courtesy of the Nelson Raspberry Marketing Committee. The canes, which arrived at East Malling in July, 1945, in the height of the summer, were at once split into three lots. One lot was sent to isolated propagating centres on Loch Tayside, in Scotland, where the canes have been successfully established; another lot was planted in isolation on a farm in the Cambridgeshire fens, and the third was used for a scientific investigation of the virus status of the plants.

That was done by growing the canes in pots in insect-proof shelters and inarching them on to specially-selected "indicator plants"—varieties of raspberries which will exhibit certain characteristic symptoms after infection by the various types of virus disease. By watching the indicator plants a diagnosis can be made of the virus status of the plants under test, including virus diseases which may be present in their sap though not causing any symptoms at all in their leaves.

STORY OF A RASPBERRY VARIETY . . .

Mr. R. V. Harris, of East Malling Research Station, has recently stated that: "In 1946 graft tests were successfully made by Dr. C. H. Cadman at Dundee on some 60 canes of this New Zealand sample (Nelson Lloyd George) and, remarkable to relate, in no instance were any symptoms of virus diseases transmitted to the sensitive indicators.

Truly Virus-free Lloyd George

"The prospects of a re-introduction of virus-free Lloyd George to Great Britain in the comparatively-near future are therefore distinctly promising, and for this we must thank New Zealand."

The reasons for this very interesting occurrence are not fully understood. It is known, however, that seedling raspberries are normally free from virus infection and, of course, most new varieties are raised from seed. Thus it can be assumed that the Lloyd George raspberry was free from virus infection when it was first found as a chance seedling growing in a wood. New Zealand nurserymen have always been eager to introduce new varieties of fruits, especially any which create such a sensation as did Lloyd George when it first reached the market. It is reasonable, therefore, to suppose that Lloyd George was brought to New Zealand soon after its introduction and before it became substantially virus infected. Under New Zealand conditions, in isolated areas, it may have remained free from virus ever since.

It may even be that some virus principles disappear under New Zealand conditions and that plants infected with certain European virus diseases can throw them off completely when planted in New Zealand. That is an attractive idea but most improbable in the light of present knowledge of plant viruses.

Export of Canes to Britain?

Nevertheless, the fact remains that New Zealand may be able to re-export to Britain healthy canes of raspberry varieties which have degenerated there. That may apply not only to Lloyd George but to other varieties like Hornet, Northumberland Fillbasket, and Red Antwerp which were once popular in Britain but have long since disappeared from commercial cultivation there.

At the same time it might pay raspberry breeders in Britain to send small stocks of their new varieties to New Zealand to be grown on in some isolated place, whence healthy plants could be sent back from time to time if British stocks became infected with virus.

It would be very interesting to know who first introduced Lloyd George raspberries into New Zealand, the firm from which it was bought, and where the first canes were planted up or distributed to in the Dominion. The Director, Horticulture Division, Department of Agriculture, P.O. Box 3004, Wellington, would welcome any information which readers can supply on these points, or on the early history of the other varieties of raspberries now in commerce in New Zealand.

Acknowledgment

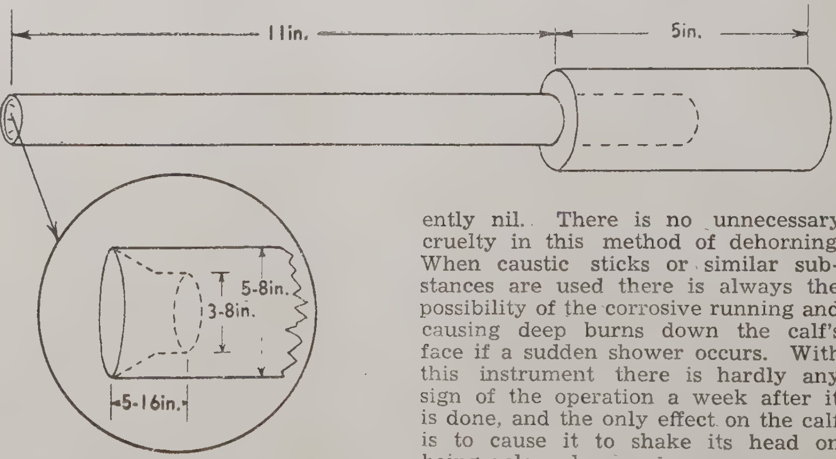
Details of the early history of Lloyd George raspberries were taken from an article by R. V. Harris in the annual report of the East Malling Research Station for 1935.

A Simple Calf Dehorner

By I. G. WATT, *Veterinarian, Auckland.*

THE simple calf dehorner described in this article has been used for some years on the farm of Mr. G. A. Pool, Tomarata. It has proved very successful and has decided advantages over the caustic stick. It is quick, cheap, and reliable. The pain and damage inflicted by horned cows on others in the herd are often reflected in smaller returns from the factory. A simpler and more reliable method of dehorning calves may induce farmers to perform the operation earlier and avoid the unpleasant task of dehorning adult animals.

THE instrument described was made to Mr. Pool's requirements by the local blacksmith. It consists of a ⅝in. diameter iron rod about 14in. long, fitted at one end with a 5in. wooden handle. The exposed portion of the rod is 11in. long, and at the end opposite the handle a ⅜in. hole is drilled 5/16in. deep and the opening bevelled to produce a thin edge.



Method of Operation

The best age at which to dehorn calves is about two weeks, as they are easier for one man to handle. Have the animals in a small yard and a fire conveniently close. Heat the iron to a dull red and place it handy. Throw a calf and kneel on it to restrain it. Hold its head with the left hand and feel for the horn bud. Bring the hot iron down firmly and press on the little knob with a screwing motion. The dehorner will not penetrate far, and when it is lifted a "button" of skin and horn bud will come away. The calf's head should then be twisted and the same operation performed on the other side.

The operation takes one man about half a minute, the result is a neat job, and the effect on the calf is apparently nil. There is no unnecessary cruelty in this method of dehorning. When caustic sticks or similar substances are used there is always the possibility of the corrosive running and causing deep burns down the calf's face if a sudden shower occurs. With this instrument there is hardly any sign of the operation a week after it is done, and the only effect on the calf is to cause it to shake its head on being released.

LUCERNE

The lucerne crop deserves a much more important place than it holds in our livestock farming. Bulletin 155, available free from offices of the Department of Agriculture, contains a complete study of lucerne's valuable features, selection of soil and situation for sowing, the preparation of the seed-bed, sowing, and general management of an established stand.

ESCHSCHOLTZIA USED AS SHEEP FEED

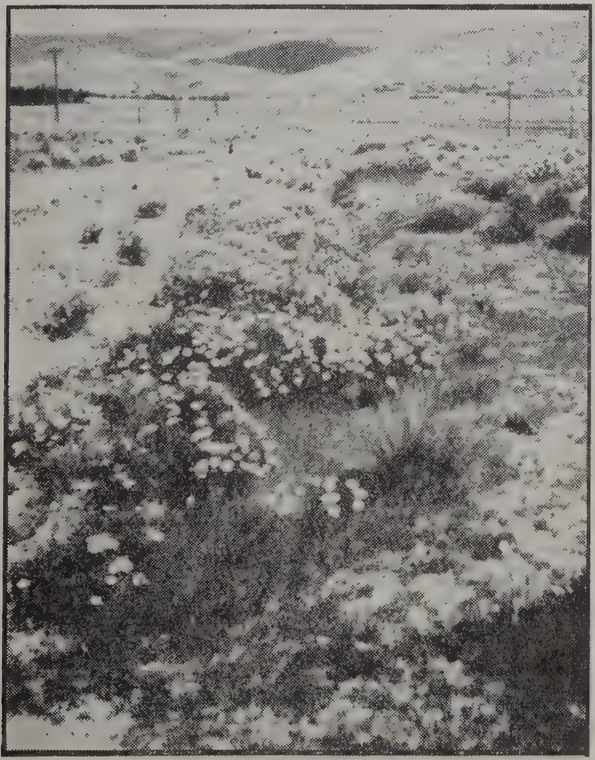
CALIFORNIAN POPPY *(Eschscholtzia Californica)* is a common plant found growing on some of the shingly river beds of the east coast of the South Island. A cultivated variety is frequently grown in gardens for the production of the brightly-coloured flowers that are also characteristic of the wild variety, which is really a garden escape.

THE plant comes away early in the spring on dry, shingly or sandy situations, and quickly produces a growth of up to 12in. of finely-divided, fleshy leaves. It is frequently the only plant of any consequence growing under such hard conditions. Although able to flourish under more difficult conditions than most grasses, it has not been observed invading grassland.

In the Bannockburn district, Central Otago, eschscholtzia is utilised as sheep feed, and although sheep prefer grass if given the choice, they will, however, eat and thrive on eschscholtzia alone. At least two Central Otago farmers are so satisfied with the value of it that they are saving the seed and sowing out further areas. These sowings are made mainly on old gold workings on which remain only sand, gravel, and stones, or on dry, gravelly faces. On this type of land without irrigation hardly any grass will grow and very few other plants are present. Consequently the sheep are grazing almost solely on eschscholtzia. It comes away as early as any grass, and in early October has a growth of 4 to 5in. As rabbits will not apparently eat eschscholtzia the growth can be saved and utilised when required.

During the 1943-44 season on a shingly river face of less than 20 acres, 250 ewes had four grazings of an average of ten days each. The grazings were made during the following periods: Early November, late December, early March, and in May (when the growth was from 8 to 12in.).

View near Bannockburn, Central Otago, where Californian poppy is being used for grazing.



Lush growth of eschscholtzia on poor ground on a Central Otago roadside.

Feeding Trial at Wallaceville

The Animal Research Division conducted a small feeding trial with eschscholtzia at Wallaceville. The plant had very low palatability, and the sheep had to be starved on to it before they commenced grazing. Once they had a taste for the plant they ate it fairly readily, but at no time did they consume an amount greater than that required to maintain their body weight. One sheep (out of four) died during the progress of the trial. Analyses of the poppy made at intervals while the plant was being fed revealed a high content of the poison hydrocyanic acid. To compare the plants used at Wallaceville with plants growing in regions where it is used for sheep feed, analyses were made of five samples of eschscholtzia growing in the Bannockburn and Cromwell areas. The content of hydrocyanic acid was found in all samples tested to be higher than that found in the plants growing at Wallaceville.

It would appear that there is a danger of hydrocyanic acid poisoning if sheep are grazed on the plant, and the possibility of stock mortality in some circumstances. Nevertheless, in Central Otago no sheep have so far been reported as having died as a result of feeding on the plant. Although sheep when grazing eschscholtzia probably consume considerably more than the lethal dose of hydrocyanic acid, the release of the poison would seem to be sufficiently slow to enable the animals to deal with it without being poisoned.

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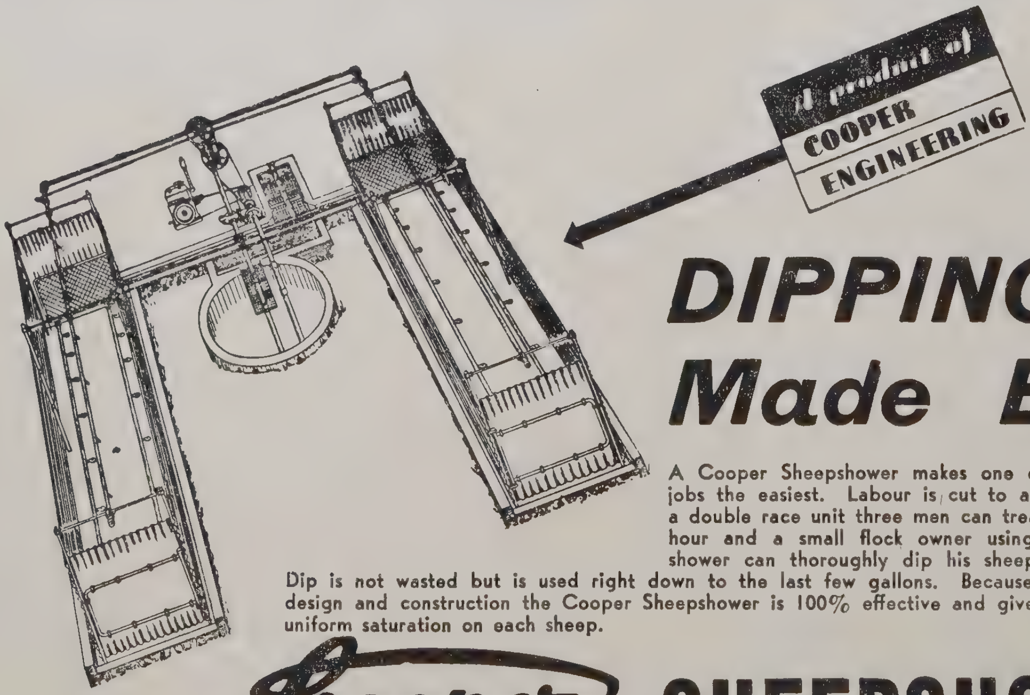

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Certified Government Stock Seeds

Making Pedigree Strains Rapidly Available

By J. H. CLARIDGE, *Agronomist, Wellington.*

IT is now over 10 years since the Department of Agriculture began to produce Government Stock grass and clover seeds, and today seed of three types of ryegrass (perennial, Italian, and short-rotation), two types of red clover (Montgomery red and cowgrass), and white clover are being distributed under this scheme. Under a somewhat similar arrangement Certified Government Stock cocksfoot seed is distributed by Lincoln College.

Applications for Certified Government Stock seeds are far in excess of the quantities being distributed each year, and naturally the question, "Why is not more Government Stock seed produced?" constantly recurs.

TO answer this question it is necessary to give some consideration to the reason underlying the production of Certified Government Stock seeds in the first place.

Wide Availability of Pedigree Strains

The various classes of Certified seeds are not separate entities, but link up very closely with one another to serve the purpose for which they are intended—to make pedigree strains of seeds available as rapidly as possible and in sufficient quantity to meet the needs of farmers establishing pastures for fodder production, who are the widest group of users. Thus the Government Stock class of Certified seeds must not be looked upon as an end in itself, simply to release pedigree strains of seeds into commerce, but as a part of a wider scheme to take these strains right through to the ordinary seed user.

The initial selection of a pedigree strain comprises a relatively small number of plants—probably not more than 10 or 12. The aim of Government Stock seed production and indeed of the certification scheme generally is to multiply this seed as rapidly as possible and with a minimum of deterioration to a stage where all seed produced is of the same strain. The number of multiplications necessary to achieve this aim depends upon two factors—first the total quantity of seed it is desired to produce, and secondly the rate of multiplication in each generation. Experience has shown that with the grasses and clovers at present affected, seven generations are adequate for this purpose. The first three of these generations are under the direct control of the institution selecting the original material. The fourth multiplication is directly controlled by the Department of Agriculture in its production and distribution of Certified Government Stock seed. The last three multiplications are represented by the three classes of Certified seed which involve production on a commercial scale.

The amounts of seed handled in the initial stages are very small. By the time the third multiplication has been completed there is sufficient seed available to establish one or more commercial areas. This seed is sown out by farmers under contract to the Department of Agriculture

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and from these areas Certified Government Stock seed is produced.

Multiplication from Nucleus Stock

From this stage onward is of most interest at the moment. Taking Italian ryegrass as an example, about 120 bushels of Nucleus Stock seed are delivered to the Department of Agriculture each year from the Grasslands Division of the Plant Research Bureau. This seed is sown out on about 90 acres under contract, and is estimated to produce 2000 bushels of Certified Government Stock seed in the following harvest. On a conservative theoretical calculation this amount of seed would in turn sow 1500 acres, which, if utilised primarily for seed production but allowing for crop failures and the like, would return 20,000 bushels of Certified Pedigree seed. Use of this Certified Pedigree seed for further seed production would lead to the establishment of 15,000 acres, capable of producing 150,000 bushels of Certified Mother seed. Allowing for the export of 50 per cent. of this quantity, sufficient seed would remain to sow out 50,000 acres, which in turn might be expected to produce 400,000 bushels of Certified Standard seed available either for use locally for general pasture purposes or for export.

In tabulated form the position is as follows:—

	Bushels
Nucleus Stock seed produces	120
Government Stock seed produces	2.000
Pedigree seed produces	20,000
Mother seed produces (allowing for export of 50 per cent.)	150,000
Standard seed	400,000

If such a programme of multiplication is visualised as continuing from year to year, the theoretical total annual production of Certified Italian ryegrass would be about 550,000 bushels. Peak production of this seed in the 1945-46 season was actually only half a million bushels of Certified and uncertified seed together. The analysis of production of Certified seed in that season is as follows:—

		Bushels
Certified	Pedigree seed	40,000
,,	Mother seed	210,000
,,	Standard seed	30,000

In other words, whereas the actual production of both Certified Pedigree and Certified Mother seeds exceeded very appreciably the conservative theoretical estimates given above, the production of Certified Standard seed fell more than 10 times short of the estimate.

It would thus seem that very efficient use of the pedigree strain is being obtained as far as the production of Certified Pedigree and Certified Mother seed is concerned, but there is a serious falling off in the use of Certified Mother seed for further seed production. It also appears that the release of approximately 2000 bushels of Certified Government Stock seed annually would be ample, if fully utilised, to enable the whole of our present production of Italian ryegrass seed to be certified.

Italian ryegrass has been chosen for this example because normally only one seed harvest is taken from an area, but the production of the other types of seeds may be analysed in a similar manner. In each instance it can be shown that the quantity of Certified Government Stock seed being released is capable, if reasonably utilised through successive generations, of ensuring that all areas harvested for seed are eligible for entry into certification. This is by no means the case today.

Single plants of short-rotation ryegrass set out for production of Nucleus seed.

Farmer's Viewpoint

If, then, the quantity of Certified Government Stock seeds produced is sufficient to meet the purpose for which these seeds are intended, why is there this repeated demand for increased supplies?

The answer to this problem must be sought in the viewpoint of the individual farmer to seed production generally and to Certified Government Stock seeds in particular. In general he is not very concerned with the national viewpoint on this subject, that is the reproduction of the pedigree strain in the greatest bulk and as quickly as possible. His view is an individual one, and in his selection of the class of Certified seed he is to sow he may be influenced by one or other of two outlooks.

A farmer may consider that the additional cost of a higher class of Certified seed is justified from the angle of pasture improvement alone, or he may be guided to use the highest class of Certified seed by his desire to have everything on his farm—stock, implements, or pastures—of the highest quality. Also, as a potential seed grower, he may be anxious to obtain the highest monetary return for his produce.

Repeated tests with pedigree strains of seeds have shown that no significant difference can be determined between the various classes of Certified seeds when pasture production alone is considered. The difference between seed of one class and another is of dimensions, which concern the seed producer only, in his endeavour to bulk up the particular type with a minimum of contamination.

Thus the introduction of one plant of Italian ryegrass per thousand in an area of perennial ryegrass to produce Certified Pedigree seed would have serious repercussions in succeeding generations of seed. But of what seriousness would this amount or even 10 times this amount of Italian reygrass be in a sowing of perennial ryegrass for pasture purposes only, when in all probability additional Italian ryegrass seed will be added to the mixture? Farmers who have no intention of saving seed from their pastures therefore need have no fears that by sowing the lowest grade of Certified seed (Permanent Pasture or Standard) they will be losing quality in their pastures.

The farmer who intends to harvest seed from his areas views this matter from another aspect. He looks at the return he is likely to expect for his seed crop and realises that the investment of a few shillings per acre in the purchase of a higher class of seed is amply repaid in the increased price he will receive for his produce. He there-

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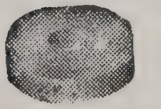

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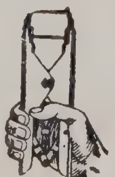

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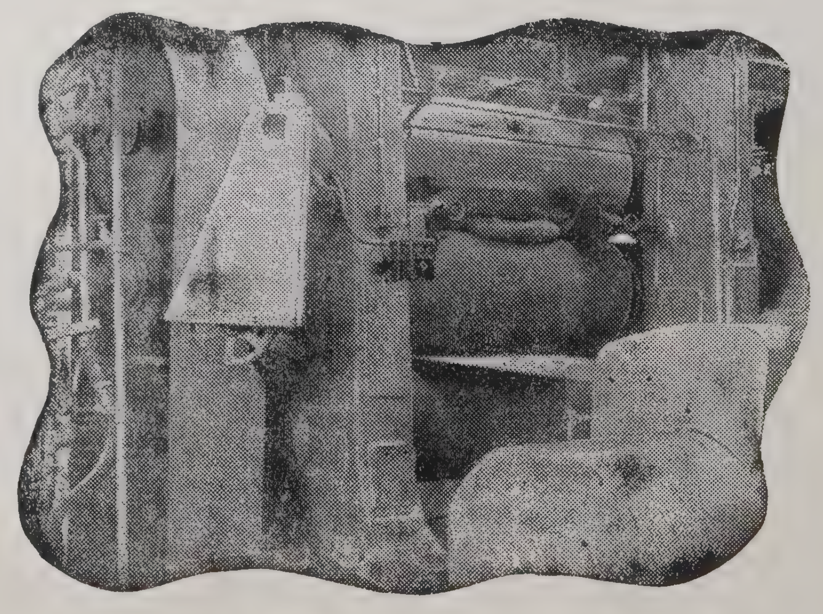

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Single plants of Italian ryegrass after 12 months under trial. Plants on the left are of the pedigree strain and plants on the right are of the natural strain.

fore seeks the highest class of seed he can—Certified Government Stock seed. The attitude of the individual farmer in this respect is fully appreciated, but the effect of increasing the production of Government Stock seed to meet his desires must be carefully examined.

Effect of Further Multiplication

The introduction of another step in the process of multiplication as a means of increasing the production of Government Stock seed would be fully justified if the existing multiplication stages were insufficient to ensure adequate seed production. The actual effect of such a move would be to redesignate the present Certified Pedigree seed as Government Stock, and so on for each succeeding generation. This is made more clear by the summary in the table below.

In other words the fourth generation of seed is at present termed Government Stock, whereas the inclusion of an additional step would result in the fifth generation of seed being so called.

The introduction of an additional multiplication stage would be unavoidable if by the seventh generation insufficient seed was being produced. It has been shown earlier in the case of Italian ryegrass, however, that virtually all the production of Certified seed occurs by the sixth generation, and that the seven generations provided for would adequately provide for the total seed production of this crop to be Certified, instead of only 50 per cent. as at present. A similar position holds with the other seeds affected.

Put very simply, to increase the output of Certified Government Stock seed to any extent would be tantamount to supplying the purchaser with seed described as Certified Government Stock which in the past he has been able to purchase as Certified Pedigree. It would result in reduced production of Certified Mother and Certified Permanent Pasture or Standard seed. It would, however, enable farmers who are anxious to do so to pay Certified Government Stock prices for seed which they can now purchase at Certified Pedigree prices.

The following utilisation of the various grades of Certified seed should maintain the proper relationship between seed-producing and non-seed-producing pastures.

1. **Certified Government Stock Seed:** To be used by the farmer who considers the claims of seed production before the claims of his livestock.
2. **Certified Pedigree Seed:** To be used by the farmer who, while not coming within the first category, still aims to produce seed on every possible occasion and stocks his farm accordingly.
3. **Certified Mother Seed:** To be used by the farmer who is in a seed-producing district and will take a seed crop if seasonal conditions are satisfactory.
4. **Certified Permanent Pasture and Certified Standard Seed:** To be used by the farmer who has no intention of harvesting a seed crop.

It is apparent that much Certified Mother seed is being used to establish pastures where seed production will never be undertaken. It is also apparent that there are many farmers yet prepared to sow the uncertified seed which is still being produced in appreciable quantity. There is everything to be said in favour of the exclusion of uncertified seed from any sowing where Certified seed of the same species is available, but there is no advantage to the farmer in using Certified Mother seed for straight-out pasture purposes. If this class of seed is utilised (as is its intention) to produce Certified Permanent Pasture or Standard Seed, and so eliminate the production of uncertified seed, then both the producer and the consumer would benefit. The former would gain the advantage of having only Certified seed to sell, together with the benefit of having better strains on his own farm. The latter would be able to obtain Certified Permanent Pasture or Standard seed for his non-seed-producing areas, and would not have to pay the higher price of Certified Mother seed or alternatively accept the lower quality of uncertified seed.

After all, the production of seed is not an end in itself, but only a means to an end—the provision of seed for the re-establishment of pastures, better pastures for preference. The present extent of Certified Government Stock seed production and the facilities available under the certification scheme generally appear adequate to meet this purpose.

* * *

THE EFFECT OF INTRODUCING AN ADDITIONAL STEP IN THE MULTIPLICATION OF A PEDIGREE STRAIN

Generation	Under the present set-up these are designated:	With the addition of an extra stage these would be designated:
1st	Glasshouse multiplication	Glasshouse multiplication
2nd	Field multiplication	First field multiplication
3rd	Nucleus Stock	Second field multiplication
4th	Government Stock	Nucleus Stock
5th	Pedigree	Government Stock
6th	Mother	Pedigree
7th	Standard	Mother
8th	—	Standard

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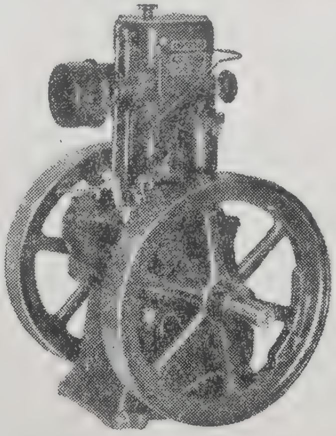

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Sanitation and Hygiene on the Poultry Farm

By S. G. HADDON, *Poultry Instructor, Palmerston North.*

POULTRY flocks have been reduced in size and number in an attempt to offset shortages of feed, but unfortunately overheads are still at their high level, with the result that the laying hen, the foundation stone of the poultry industry, has a bigger load to carry than ever before. Any practice, any methods or systems of routine, which will help to lighten this load must be worth studying. Among these considerations are those dealing with hygiene and sanitation.

A DICTIONARY defines sanitation as "the devising and applying of measures for preserving and promoting health, and the removal or neutralisation of elements injurious to health;" and hygiene is defined as "the branch of medical science that relates to the preservation and improvement of health." Note the emphasis on health.

Apart from sound breeding methods, there are two ways of attacking this problem of "preserving and promoting health." One is by developing routine habits and methods which are clean, neat, and tidy; the other is by the use of soundly-designed equipment used in a common-sense fashion.

The first habit which should be cultivated is that of cleanliness, and it should be apparent in the condition of the foodshed, mixing room, egg-room, and incubator room, and the state of buckets, mixing troughs, and other equipment. This cleanliness has another advantage: Clean tools and equipment last longer and need less repair than dirty tools and equipment. The time spent maintaining cleanliness is negligible, though getting an article clean often takes more time than keeping it clean. Cleanliness is emphasised because most diseases are carried by dirt and thrive in dirty surroundings.

Incubator Room

The year's work on a poultry farm may be regarded as starting with the incubation season. The incubator room should be the cleanest, tidiest room on the farm, but it rarely attains to this state. Keeping an incubator room clean and tidy should not be difficult. In any case, a thorough clean-out of the room and its contents (including the incubators) is indicated before the start of each season.

There is no need to invest in rare and unusual disinfectants for this purpose. A thorough sweeping, followed by a scrubbing with hot soap and water and a hard brush, will work wonders. A small amount of washing soda or commercial disinfectant, at the maker's recommended strength, may be used in the water if desired. The interior of the incubator, egg-storage racks, and shelves should receive the same treatment.

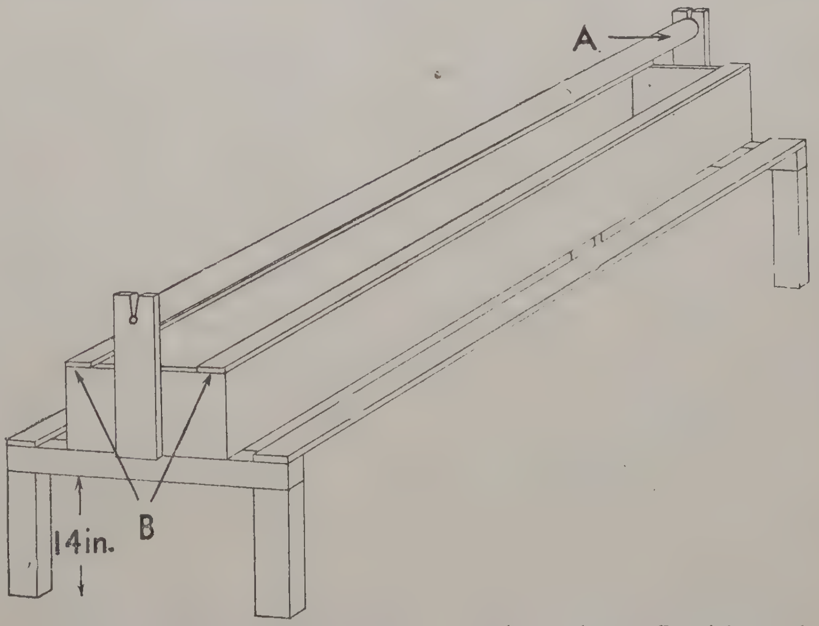
As a final check, the incubator should be warmed up and fumigated with Condy's crystals and 40 per cent. commercial formalin. The active fumigant is formaldehyde gas, which has a very irritating effect on human eyes and noses. The correct strength for sufficient fumigation is 17.5 grammes (½oz.) of Condy's crystals and 35 cubic centimeters (1oz.) of formalin to each 100 cubic feet of space in the incubator. Multiplying the three dimensions of the incubator together will give the cubic measurement, from which it is simple arithmetic to work out the amounts of ingredients required. For satisfactory fumigation the humidity in the incubator should be as high as possible. Chick boxes and small incubator room fittings may also be fumigated by placing them in a reasonably air-tight box. The duration of fumigation should be 20 to 30 minutes.

Brooder Pens

Incubation leads to brooding, and cleanliness is again the keynote. The brooder pens have often been empty for several months by the time the first hatch is due, and dust and cobwebs have a habit of accumulating if allowed to do so. As with the incubator room, begin with a thorough sweeping with a stiff broom, followed by scrubbing with hot soap and water all utensils and equipment which will be used. These should have been cleaned and scrubbed as they came out of use at the end of the previous season and should not require much time spent on them.

All woodwork in the pens, for a height of at least 3ft., will benefit by a dressing of creosote, at once a wood preservative and a disinfectant. If the pens are earth floored, clean, fresh soil from an isolated site should have replaced the previous season's filling. Concrete or wooden floors may be scraped to remove caked dirt, then soaked and scrubbed, and finally soaked with the recommended strength of any commercial disinfectant.

Where coccidiosis has been experienced, one of the best treatments is to soak the floor and walls with a 10 per cent. solution of commercial caustic soda. This solution should be left on until dry, after which the walls and floor require swilling down with plain water. Scorching with a flame-thrower or blowlamp also helps, but does not deal satisfactorily with dirt and germs in deep cracks. Metal or wood and fibre board canopies may also be fumigated if desired by the formaldehyde



A removable feeding trough mounted on a simple stand. A—Revolving reel to prevent birds perching. B—Lips along top to prevent waste.

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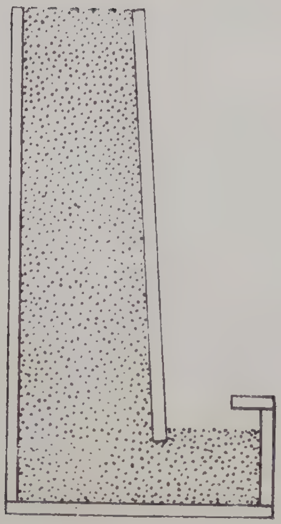


A wall type dry-mash hopper. The lip along the front edge is designed to prevent waste.

method recommended for the incubator room.

Rearing and Growing

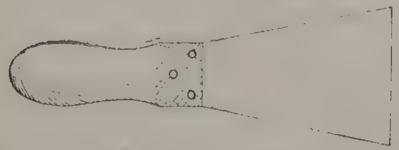
Next comes the rearing and growing stage. Whichever system is used—intensive, semi-intensive, or free-range rearing—all equipment and housing should be absolutely clean and in good order before being put into use.

Rearing equipment often includes wire-netting floors. With removable floors a few days' exposure to rain will soften the hardest crust of dirt, which can then be swilled off with comparative ease; subsequent cleaning will follow normal lines. To clean fixed floors recourse must be made to the stiff wire brushes obtainable from engineers' and hardware stores. The wire floors are "dry cleaned" with these, followed by scrubbing with hot water and soap.

As with brooder sheds, all woodwork of arks, colony houses, and range shelters will benefit from a dressing of creosote. All movable housing should start the season on a new patch of ground.

Laying Houses

There should be no necessity to stress the need for a thorough cleaning and overhaul of the laying houses before their occupation by the new season's pullets. The work would follow the lines already indicated—soaking and scraping the floors to remove caked dirt, removal of dust and cobwebs from wire fronts, rafters, ledges, and nest boxes, creosoting all woodwork, and repairing defects or damage. So much for what may be termed "seasonal precautions."



A useful scraper for cleaning feeding troughs and other equipment.

The most important danger spot in any poultry house is the watering system. All birds use it, and one diseased bird may infect the whole house. Therefore, whatever their design, drinkers must be maintained in strict sanitary condition. That entails daily cleaning and scrubbing with the ordinary kitchen sink type of brush. A brush of this type hung on a nail by the side of each drinker is a useful reminder and a worth-while investment.

Another essential with drinkers is to safeguard the floor of the shed against accidental flooding. That can be achieved by fitting an overflow pipe capable of handling more than the tap can deliver. The best of automatic systems sometimes stops working as it should and continues to release water into an overflowing drinker.

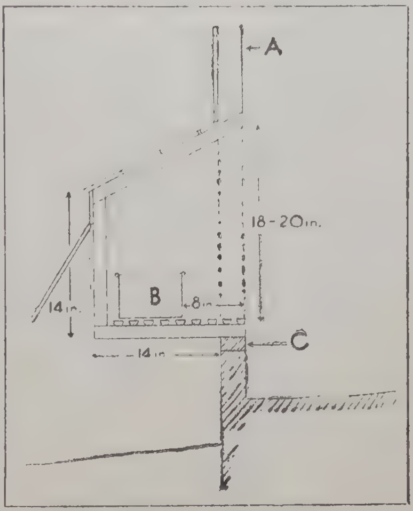
A further precaution is to locate the drinker outside the house proper, so that any overflow does not reach the floor of the shed. This type of drinker is usually placed on a substantial wire-mesh rack or on wooden slats. In either case it is protected from the elements, particularly hot sunshine, by a hood built out from the wall of the shed.

If drinkers must be inside the shed, place a large metal tray underneath the drinker stand to catch drips. This tray will do away with the sticky patch of wet litter often found around the inside drinkers. Such patches are largely responsible for dirty eggs in the nest boxes, particularly when a flock is kept intensively, and avoiding them will remove a lot of the drudgery entailed in cleaning eggs.

Hoppers and Troughs

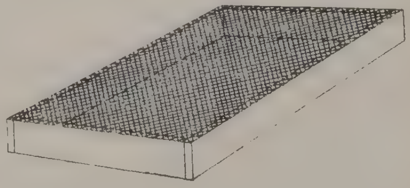
With dry mash feeding every endeavour should be made to use only types of hoppers which allow the birds ready access to the mash but are non-spillable. The usual manner of achieving this is to have a lip about 1in. wide projecting inward over the trough of the hopper. The feeding space should be narrow enough to keep birds from scratching in the trough but wide enough to allow them ready access to the mash.

Where wet mash or soaked grain is fed in troughs, all food left in them should be collected when it is obvious that the birds have had their fill. The wedge-shaped paper-stripper used by house decorators is a useful tool for scraping these troughs, and, indeed, can be used for a multiplicity of tasks around the farm.



External water trough to prevent overflow from reaching the floor of the poultry house. A—Front wall stud. B—Drinker standing on bevel-edged slats. C—Bottom plate.

Prevention of contamination of food and water by young chicks is difficult. The youngsters grow so rapidly that anything in the nature of a guard or opening of a limited size is too small before it is realised, with the result that the chicks can no longer obtain food and drink readily. All that can be done is to arrange food and water vessels on woven wire mesh, or ½in. mesh netting platforms, placed over trays or sheets of paper. Any food spilt is thus saved from being mixed with litter and lost.



A mesh-covered frame to support chick drinkers or mash troughs. The sides are made from 3in. x 1in. dressed timber, and the top is ½in. mesh wire netting or woven wire.

Ranges and Runs

Range areas, runs, and cultivated areas all play parts in this sanitation programme. The simplest and most efficient way of keeping a free range area in good heart is by grazing it with sheep or lambs. These animals are large enough eaters to keep down excessive growth, but do not damage housing or equipment. If a small flock of sheep is being run on a range already occupied by growing birds (which can be done without detriment to either), make certain that the sheep cannot gain access to the food hoppers of the young stock, or the food bill will go up and the grass remain uneaten. Runs attached to breeding pens and laying houses will benefit by the same treatment.

It is sometimes necessary to scythe or mow the heaviest rank growth before introducing sheep into a pen. That has the dual purpose of letting the sun into the rank patches and encouraging the sheep to fossick after the new growth which follows the mowing.

The method of construction of the runs can facilitate or obstruct this sort of work. Large wire-netting panels which may be easily removed are well worth considering, particularly if the run-cleaning programme includes cultivation and cropping of resting and unused runs. Cropped runs provide a valuable addition to the farm's greenfeed supply.

Disposal of Droppings

So far, no mention has been made of disposal of droppings, that fruitful source of trouble. In the past intensive housing without dropping boards has been popular. In hot, dry areas this may be satisfactory, as the droppings soon dry out and become harmless, but in colder, damper areas that is not so and precautions against contaminated droppings must be taken. These may consist of dropping boards under perches, which require frequent cleaning to be satisfactory, or the perches may be wired in, thus denying the birds access to the accumulated droppings. In properly-ventilated houses these dropping pits do not become noisome or smelly and require cleaning only at moderate intervals.

With chicks in the brooder stage, the common-sense treatment is to use a wire floor, which isolates the chicks from their droppings and also ensures a copious supply of fresh air under the canopies.

Treatment of the droppings after collection and removal will vary from farm to farm. Sale of poultry manure can be a useful source of income, particularly if the farm is near a market-gardening area.

Importance of Incinerator

The incinerator is an important piece of equipment which is lacking on a surprising number of farms. A 44-gallon drum, with a fire hole cut low down in one side and a grate of iron bars above it, will work quite efficiently. It is important, though, to build and maintain a good fire under the grill to burn all the rubbish and dead birds which will invariably accumulate in it.

There is no quick road to successful sanitation. It is brought about only by attention to detail and common-sense application of sound principles.

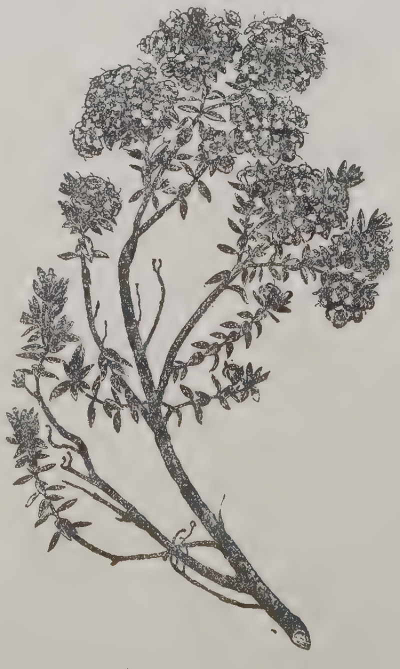
Strathmore Weed

By A. M. LEE, *Fields Instructor, Wairoa.*

THE spread of Strathmore weed *(Pimelia prostrata)* in pastures in certain districts is causing some concern. The use of fertilisers and intensive stocking do not appear to diminish its growth greatly, and on pumice soils in the southern Hawke's Bay and Gisborne districts the plant is very common. Stock will not graze it and even goats, which are very effective scavengers of blackberry, appear to shun it.

STRATHMORE weed is also known as rice weed and wild sage, and the Maoris call it wharengarara, a singularly appropriate name, because the plant is indeed "the abode of insects" or "the home of the lizard."

This rather attractive little native plant belongs to the same order as the daphne, which contains a number of well-known garden plants. Many of the species in this order are acrid and caustic, such as the spurge laurel and mezereum, both of which are used in medicine. The roots of several species furnish a yellow dye and the tough inner bark of others is employed for cordage.



Small branch of Strathmore weed *(Pimelea prostrata)* about half natural size.

Pimelea, the genus to which Strathmore weed belongs, is found elsewhere only in Australia, where it is largely developed.

Strathmore weed occurs in the Three Kings Islands and throughout both the North and South Islands and is abundant from sea level to an altitude of 4500ft. The flowers and characteristic white ovoid berries appear from October to April. There are several varieties which are very variable and difficult to define. According to Cheeseman the plant is almost polymorphous and there is a great need of careful botanical study and comparison of its various forms.

For many years Strathmore weed has been suspected of causing the poisoning of livestock, the first recorded instance being in the Strathmore district of Taranaki in 1900, when horses were reported to have been poisoned by it. Since then periodic cases of poisoning have been noted.

Its danger is greatly minimised by the fact that stock do not eat it at all readily because of the burning sensation which it produces in the mouth.

Affected animals, which are mainly horses, should be treated with a purgative such as linseed oil followed by stimulants such as strong coffee in liberal doses at four-hour intervals.

Harrowing with heavy tripod or tine harrows followed by heavy liming and the usual applications of phosphatic fertiliser has effected some control of the weed. The harrows disturb the long, wiry, prostrate stems and stock are able to graze the pasture plants growing through the weed, thus effectively checking the further growth and spread of the plant and ultimately eliminating it from the sward.

Another reported treatment of the weed was hand hoeing followed by applications of lime at 5cwt. per acre and superphosphate at 2cwt. per acre. Where it has encroached extensively on pastures ploughing or giant discing is a more suitable method of eradication.

Acknowledgment is made to Cheeseman's "Manual of the New Zealand Flora" for botanical description and distribution and to Mr. A. T. Carroll, Hurumua, for interpretation of the Maori name.

SHEARING MACHINES

Bulletin No. 234, "Shearing Machines," will be of value to shearers and farmers with their own shearing plants. It gives a detailed description of the shearing plant, and the different handpieces used in New Zealand. This bulletin will teach the shearing machine owner how to maintain and repair his plant. Write or call at the nearest office of the Department of Agriculture for this and other informative booklets.

PEAS GROWN IN HEDGE FORM

THAT tall-growing peas have advantages over the dwarf varieties both from a commercial and a domestic viewpoint has been shown by an Auckland grower who makes a practice each year of growing a hedge of peas 180ft. long. The variety used is the Alderman, which grows to a height of 8ft.

By S. O. GILLARD, *Instructor in Vegetable Culture, Auckland.*

THE Alderman variety produces long, straight pods, each containing an average of nine large peas of delicious flavour. The average annual crop obtained from the 180ft. row has been 350lb. of good-quality pods—almost 2lb. for each foot of row. Harvesting has been completed by the end of December, and, sold at an average of 9d. a lb., the crop has returned more than £13.

The high yield per foot of tall peas makes them a profitable proposition, especially where garden room is limited, and the height at which the crop is carried makes harvesting faster and much less tedious. Harvesting also covers a much longer period than it does with the dwarf varieties.

Shelter from high winds is necessary and good soil conditions are advantageous. To give adequate support to the vines 6ft. wire netting is used and is supported by a four-wire fence, the bottom of the netting being 6in. above ground level. Extra support to the vine above 6ft. 6in. can be given by running an extra wire 9in. above the netting. Posts can be placed 15ft. apart with lengths of 3in. x 2in. timber attached to give the required height. For the home garden 8 to 9ft. lengths of 3in. x 2in. or 4in. x 2in. timber driven 12 to 18in. into the ground at 10ft. intervals and with top and bottom wires should provide adequate support for the netting.

Manurial Requirements

It is advisable to manure fairly heavily to provide ample food supply, and the area should be given a dressing of lime some time before planting. A week or two before planting the ground should be deeply worked and a mixture of superphosphate and blood and bone in equal parts spread at the rate of from 1 to 1½lb. per 6ft. of row according to the natural fertility of the soil.

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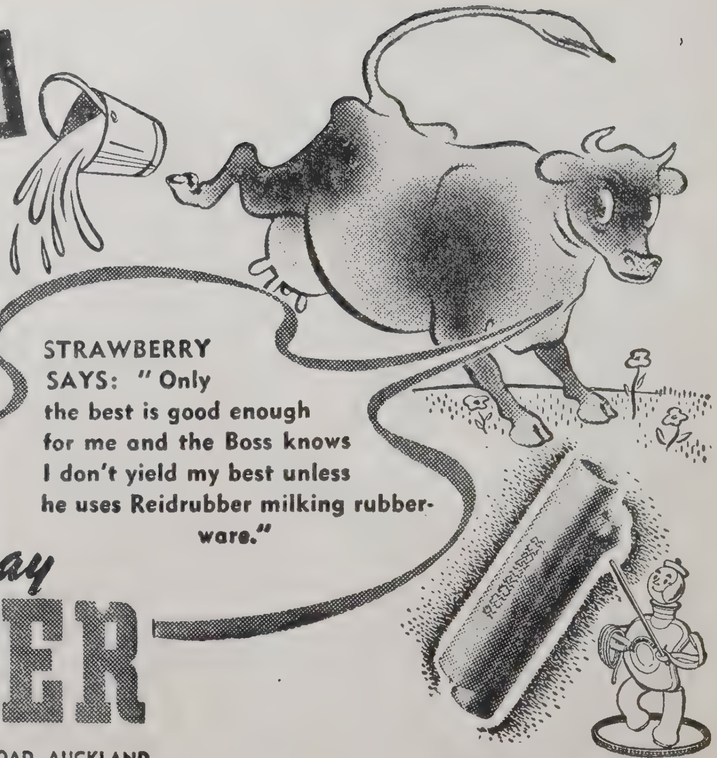

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A row of seed is sown each side of the fence, the rows being 6in. apart. One pound of seed is sufficient for about 100ft. of fence row and should be sown about 1in. deep with 2in. between seeds. Harvesting should commence 90 to 100 days from seeding.

When the plants are 18in. high they usually need added support, especially if at all exposed to winds, and this can be provided by running binder twine along the row and tying it to the netting every 6 to 8ft. Further support can be provided as the plants grow.

Tall varieties such as the Alderman require much more moisture than medium or dwarf kinds, and a watch must be kept to see that they do not suffer from lack of water at any period. Cultivation consists of fairly frequent shallow hoeings to suppress weed growth and aerate the soil after rain or watering.

Commercial growers, especially those operating under conditions of intensive cultivation, would no doubt find this variety a profitable venture.

Place in the Home Garden

The Alderman variety offers the home gardener with a small garden the solution to the problem of how to grow sufficient peas for the Christmas dinner. Two rows along a fence 10ft. long should yield between 15 and 20lb. of peas. The requirements are: Sufficient shelter from strong winds; a reasonably-fertile soil (soils can be improved by trenching and digging in compost); the application of a liberal dressing of fertiliser, such as blood and bone and superphosphate; and frequent applications of water in dry weather.

A double row of peas requires sufficient room each side of the fence for picking the crop, and this is not always convenient in a small garden. However, quite a satisfactory return may be secured from a single row which can be grown against the sunny side of a garage or washhouse or along the northern side of a hedge sufficiently high. Planting should not be too close to the hedge, however, because of the hedge roots.

All photographs in this article by Sparrow Industrial Pictures Ltd.

VEGETABLE GROWING IN THE HOME GARDEN.

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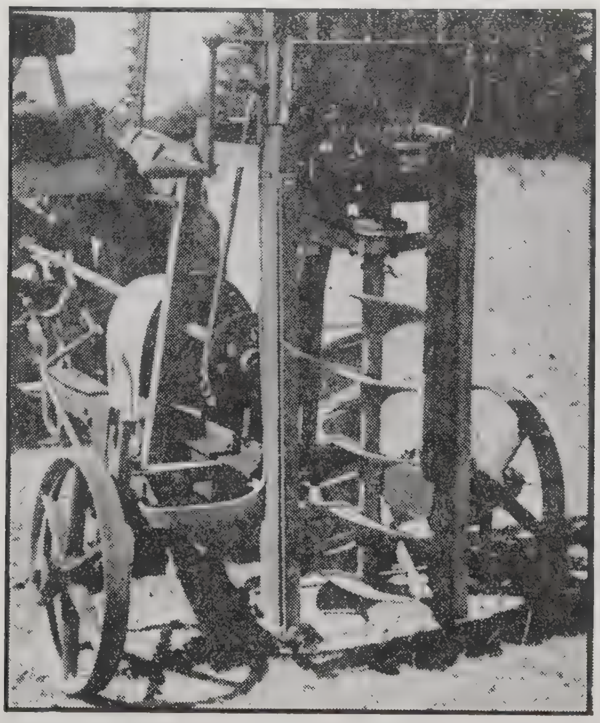
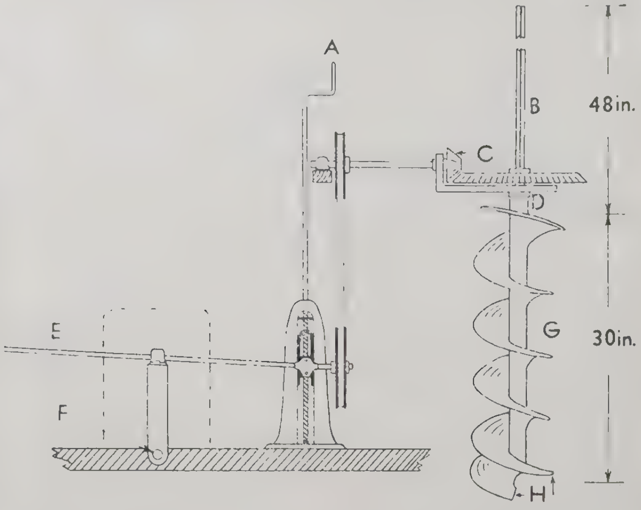
PEAS GROWN IN HEDGE FORM

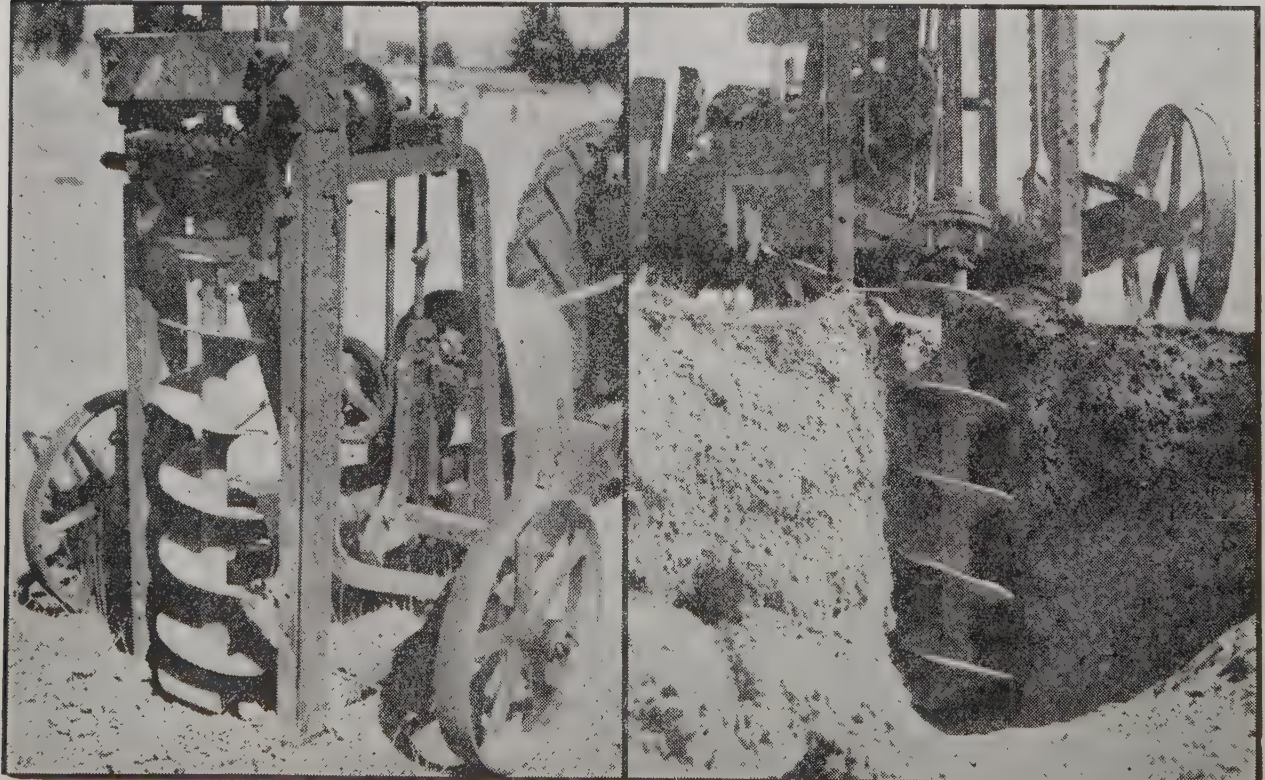
CONSTRUCTION AND WORKING OF HOME-MADE POST HOLE DIGGER



The digger ready to commence work on a slope. The shaft has been brought into the perpendicular position by an adjustment to the adjustable wheel.



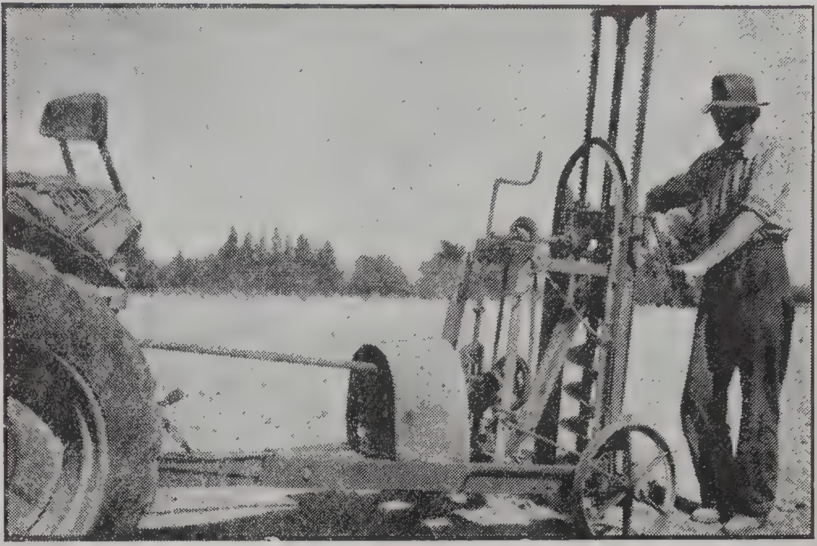
A—5/8in. rod with long-thread handle for adjusting belt drive. A ferrule on the bottom passes through a threaded sleeve and a bracket which rises and falls in guides. B—1¼in. shaft with key way which slides down through the boss of the cog wheel, which is provided with a key to fit the key way. C—Bevel cogs giving a reduction ratio of about 3 to 1. D—The 1¼in. shaft fits into piping of the auger and is held with a 5/16in. key with a wing nut for easy removal. E—Connection to tractor power take-off. F—Bracket free to pivot slightly with the rise and fall of the V pulley at the lower end of the belt drive. G—8in. auger welded around 1¼in. steel boiler piping. H—Double cutting edges for balanced cutting and cleaner removal of earth.



Left—The auger entering the ground. Rubble is left on the edge of the hole. Right—A post hole cut away to show the action of the auger.

A HOME-MADE POST HOLE DIGGER

By R. THAINE, *Assistant Fields Instructor, Wellington.*



THE construction of fences has always been considered a most laborious task and in recent years great difficulties have been experienced in fencing maintenance because of labour shortages. Mr. A. O. Hammond, of Fairhall, Marlborough, has overcome his fencing problems by making a post hole digger capable of digging 40 holes in an hour with a depth of 26in. and a diameter of 8in. Except for the drilling shaft, or auger, which was made by a local firm to Mr. Hammond's specifications, all the material used to make the machine was found on the farm, mainly from equipment which had outlived its usefulness. Mr. Hammond considers that the building of this post hole digger is well within the scope of the average farmer.

THE digger is driven by a power take-off from a 12-14 h.p. tractor, the power demand of the machine being very small. The haulage link-up is similar to that used with most tractor-drawn implements and machines, but has the advantage of an adjustable hitch which allows a variation between the level of the digger drawbar in relation to that of the tractor. The whole operation of attaching the digger to the tractor takes only a few minutes.

Easily Transported

The digger has been built so that it can be easily transported and it is therefore possible to take it over any country where a tractor can be driven. The change-over from the working to the transport position is very simple and is done by lowering one wheel, which lifts the boring shaft clear of the ground. If, however, the machine is to be taken over a long distance the screw is detached by the release of a bolt and thumb screw which connect it with the main driving shaft.

Working Range

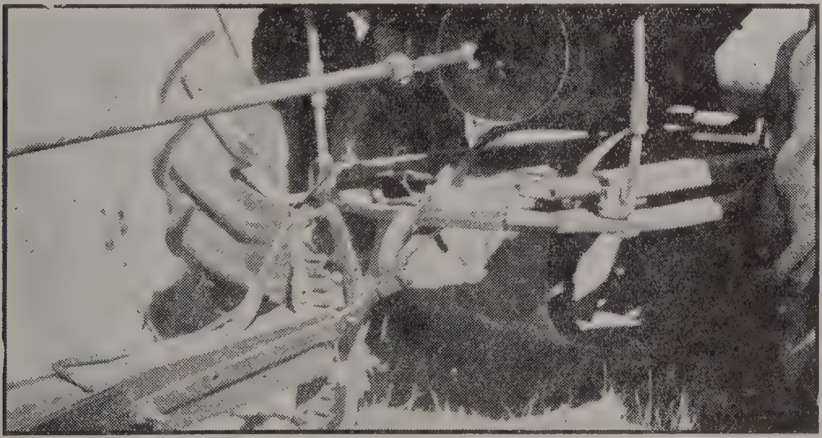
The post hole digger will operate efficiently over a large range of soil types, and though it works quite well in light shingle, it will not work successfully where there are large stones or boulders. Speed of working is reduced in very dry soils, for they are usually broken into powder by the screw and the earth is therefore not cleared from the hole so rapidly.

Hillside Fencing

In designing the digger Mr. Hammond made provision for its use in the building of fences on hill country—an important consideration in New Zealand, where a large proportion of fencing is carried out on slopes. One wheel of the machine was originally the platform wheel of a standard grain reaper and can be raised or lowered. When working on a slope this adjustable wheel is placed on the lower side and is adjusted so that the working column of the machine is brought into a perpendicular position. The wheel enables the machine to work efficiently on slopes up to 25 degrees.

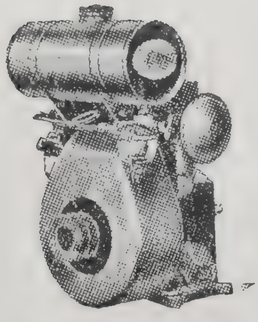
A belt drive is used between the power take-off shaft and the driving shaft to prevent damage to the machine should the screw strike any solid object. A platform wheel adjustment, which also came from an old grain reaper, is used for tightening and slackening the belt, thus preventing any major breakages.

The simplicity of construction of this machine should enable any farmer to build it without difficulty. Where fence erection and maintenance present a problem time spent on the building of such a machine will be well worth while.



Method of attaching digger to tractor.

Photographs used to illustrate this article by G. McCusker.



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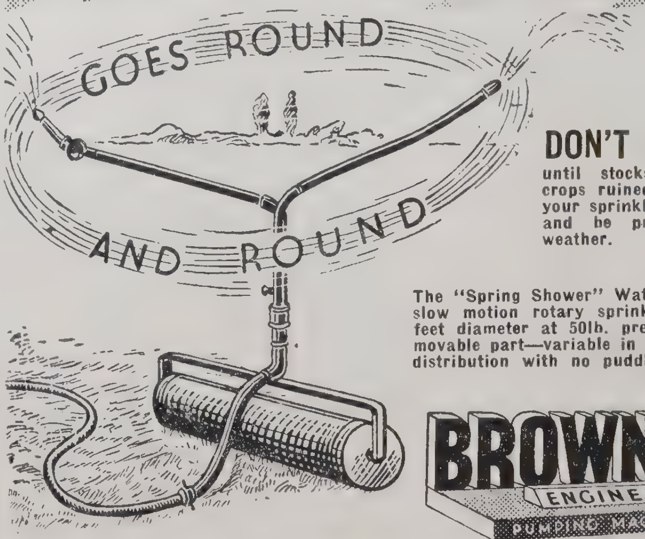

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Growing Plants in Pots and Boxes

IN the first section of this article, published in last month's issue of the "Journal," J. P. Hudson, Horticulturist, Wellington, dealt with the preparation of soils and composts for the growing of plants in pots and boxes. In this concluding section he discusses the various containers used for growing plants, the method of raising and pricking out seedlings, and the potting of young plants.

BECAUSE of their limited capacity, pots and boxes can at best provide plants with only a poor alternative to the greater bulk of soil in the garden beds. As this lack of soil is inevitable, the receptacles chosen for growing plants should provide as nearly as possible ideal conditions in other respects.

Some strange types of containers are used by home gardeners for raising plants, and it is true to say that the treatment given to the plants is more important than the shape or size of the receptacle in which they are grown. Some containers are, however, much more convenient than others and the traditional wooden seed trays and unglazed plant pots are hard to beat.

The great majority of plants grown in the home or garden need a moist, well-aerated soil which does not become waterlogged even for a short time when it is watered or when it rains. Seed trays and plant pots have been designed to prevent this temporary waterlogging by providing for rapid drainage and the aeration of the soil, which is equally important.

Seed Boxes

Seed boxes (trays) are shallow wooden boxes made so that there is a narrow gap not more than about ⅛in. wide between each of the bottom pieces, thus providing for rapid drainage of the soil.

The exact size of the seed boxes is not important to the home gardener, but commercial nurseries prefer boxes of uniform size, as they lie more snugly side by side without leaving wasteful gaps and spaces between trays. The most popular size with nurserymen measures 21in. x 14in., but this box is heavy to carry about when filled with soil, and home gardeners usually prefer something smaller.

Apple boxes can be cut down to make trays 18in. x 11½in. (internal dimensions). Even this is still rather large for most home gardeners, for whom the ideal size measures about 14in. x 8½in. inside.

Whatever size of box is used it should not be more than 4in. deep at the most, and a depth of only 3in. is preferable. Deeper seed boxes are heavy to lift and carry when filled and require much larger amounts of soil to fill. Moreover, it is difficult to remove grown plants from them without damaging their root systems more seriously than when lifting them from shallower boxes.

In these days of timber shortages the home gardener has to use any wood for making his seed trays, but trays made from ordinary soft woods have a short life, usually not more than a single season.

This can be extended by treating the boxes with one of the proprietary wood preservatives which are offered for sale for this purpose. On no account should seed trays

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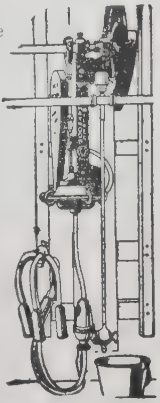

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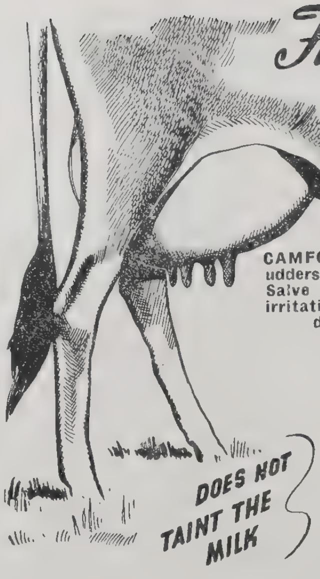

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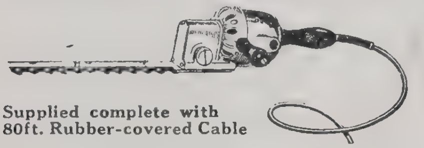

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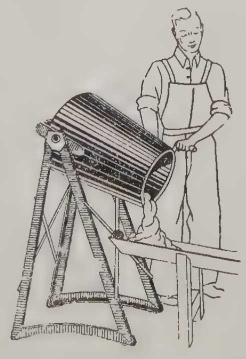

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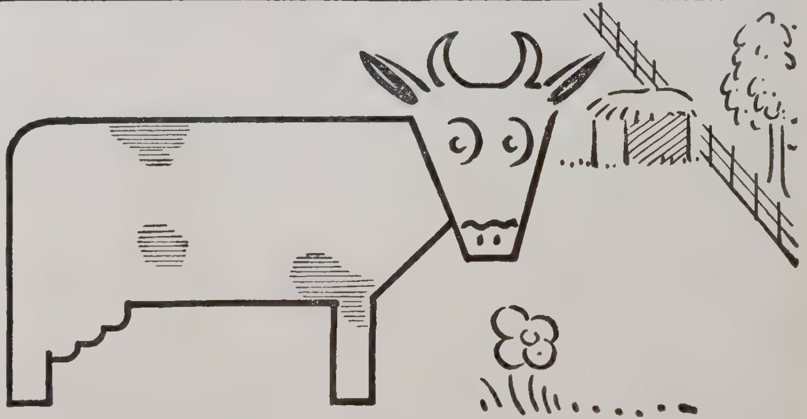

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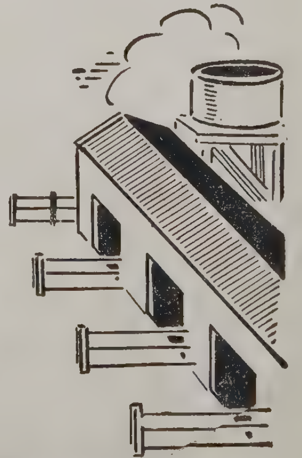

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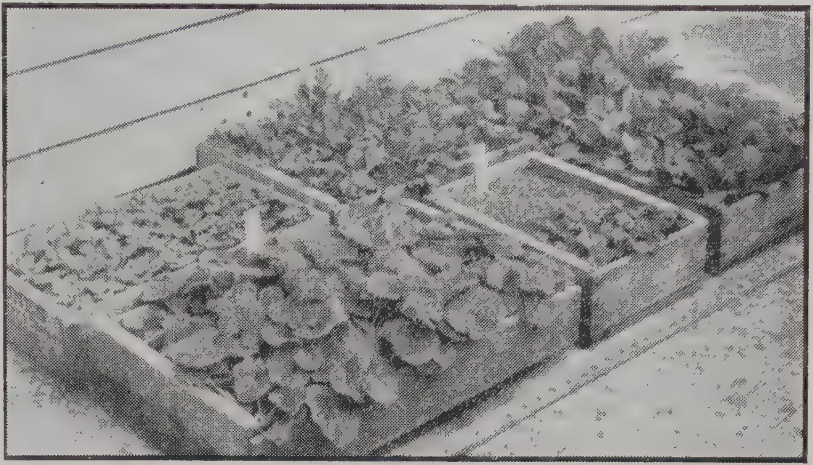


Home-grown seedlings in boxes made from box wood. The box on the left end of the front row was made by cutting down an apple box, and the box in the centre of the same row was also made from an apple box, but is half the size of the other.

be creosoted or tarred unless they can be left outside for at least a whole season before being used; even then there is a chance of harmful creosote vapours being given off from the wood if the boxes are put in a warm glasshouse.

Plant Pots

Plant pots are made from unglazed earthenware. The earthenware is porous, allowing for a certain amount of lateral circulation of air and moisture. In addition, each pot has a substantial hole in the bottom through which surplus moisture can escape, ensuring that the soil can never become waterlogged through over-watering, provided that the hole does not become choked up.

Brand-new pots are bone dry after being fired and absorb water like blotting paper. If plants are potted in these, the clay will rapidly dry out the soil and extract valuable plant foods. It is therefore essential always to soak new pots in water before they are used, and failure to do this may result in very poor plants. The pots must, however, then be allowed to dry superficially before being used. Even after this drying the porous earthenware will still hold sufficient water to prevent it from absorbing water from the soil put into it.

The sizes of plant pots vary from very small "thimbles" to pots 14in. in diameter and suitable for quite large decorative plants. Pots are usually sold in New Zealand according to their internal diameters, such as 3in., 5in., etc. In Britain it is more common to refer to pot sizes by "cast number"—that is, the number of pots which can be made from a cast of clay of uniform size; 60 3in. pots or 48 5in. pots can be made from a cast, and these pots are referred to as "60's" or "48's" respectively. This is confusing, but references to pot cast numbers are so common in gardening books that it is necessary to understand their significance.

"Pans," "Saucers," and "Jardinieres"

Unglazed earthenware "pans" are sometimes sold by seedsmen, although they are not seen now as often as they used to be. A pan is similar to a pot, but is only about half as deep. Pans are useful containers in which to sow seeds or prick out seedlings, for which a great depth of soil is actually a disadvantage.

Victorian housewives used to be fond of hiding the utilitarian ugliness of plant pots by standing them inside glazed and ornamental "jardinieres." An inch or two of drainage water usually collects in the bottom of the jardiniere, where it soon becomes smelly and objectionable, quite apart from its bad effect on the lower roots in the pot, which are standing in stagnant water.

Jardinieres have gone out of fashion, but pots of plants in the house must obviously be stood on something to avoid damage to the window-sill or furniture and to catch any surplus water which may drain through the pot.

Ordinary glazed saucers or plates are often used, but the connoisseur uses unglazed plant pot "saucers" of the same material and red colour as the pot. These have the disadvantage of being porous and therefore wet and mark the window-sill or table on which the plant is standing. This can be overcome by painting the bottom of the saucer when dry with several coats of paint to make it impervious to water.

Other Containers

Various types of other receptacles can be used for growing plants, but only those with a drainage hole in the bottom can be considered satisfactory. Without provision for drainage the slightest over-watering may ruin the plants, and it is hard to regulate watering with such nicety.

Tin trays made by cutting kerosene tins in half lengthways and turning over the sharp edges are quite satisfactory if a number of holes are punched in the bottom of each tray.

Glazed bowls can be obtained in many shapes and sizes, but unless they have a hole in the bottom for drainage, they are not really suitable for growing plants, except for the rather special purpose of growing bulbs in bulb fibre.

"Pots" made of special types of heavy waxed paper, glazed cardboard, and other materials are used by many gardeners and nurserymen. They are not, of course, as permanent as earthenware pots, and as a rule can be used only once, but they have the advantage of being much cheaper than pots.

Cleaning Pots and Boxes

Pots or boxes which have been used before should always be scrupulously cleaned both inside and out before being used for another batch of plants. If small hard lumps of soil are adhering to the inside of a pot when it is used, roots will enter these lumps and be broken off when the plant is next turned out for inspection or removed for potting.

The best way to clean pots is to scrape the outside with an old kitchen knife to remove the green incrustation and "furring," and then to scrub the pot inside and out with a stiff household scrubbing brush. The addition of a little household ammonia to the water is said to make pots easier to clean, but they should always be rinsed in clear water after using ammonia.

It is not advisable to use acid for cleaning pots, as is sometimes recommended, because this removes from the pot valuable plant foods absorbed by the earthenware during its previous use.

After being scrubbed pots should be stood upside down to drain and left until dry. This is most important, as a finished job of potting cannot be made with wet pots.

Boxes are most easily cleaned by scraping them out with a metal scraper such as a putty knife, but they cannot, of course, be cleaned as thoroughly as pots, nor is it necessary to do so.

GROWING PLANTS IN POTS AND BOXES . . .

Sterilising Pots and Boxes

There is obviously no point in going to the trouble of sterilising the loam if the compost is to be used in dirty pots or boxes which may be carrying disease infection from the plants previously grown in them.

The easiest way of sterilising boxes is to dip them in boiling water for a few minutes in the laundry copper. Pots should be put into cool water and brought to the boil. They can be strung on strings to make it easier to lift them out of the boiling water. Broken pots ("crocks") which are to be used in potting should also be sterilised by putting them in a cotton bag and dipping them for a few minutes in the boiling water.

Detailed attention should also be paid to other matters of hygiene such as not putting compost on a dirty bench or floor, where it may be contaminated. No unclean material or tools should be allowed to come in contact with the plants concerned. These precautions may sound difficult to follow, but are not, in fact, irksome to put into practice.

RAISING SEEDLINGS

Seeds require warmth, moisture, and air for good germination. Many failures in seed raising are caused by using too fine a soil, which cakes when watered and so excludes air from the seeds, or through sowing in too cold a soil.

By sowing seeds in the John Innes seed compost, described in the first section of this article in last month's "Journal," they can be assured of the correct degree of moisture and air for germination. The advantage of sowing in pots or boxes is that they can be stood outdoors, in a frame, or in the house to provide the degree of warmth most appropriate for the particular seeds concerned.

A young kentia palm growing in a 5in. pot and standing in a 4in. unglazed saucer makes a neat, serviceable house plant which will thrive in a relatively-dark corner and which needs repotting only about once a year.

Preparing Pots

When filling pots or boxes for seed sowing the compost should be in "potting condition" (which was explained in the first section of this article) and should be firmed evenly. This is most important, especially in boxes, as uneven filling leads to uneven drying out and usually results in considerable variation in size and sturdiness of plants between one part of the box and another.

Pots of 4 or 5in. diameter are the best size to use for seed sowing, as larger pots involve the use of too deep a soil, from which seedlings cannot readily be lifted without injuring their roots, and smaller pots tend to dry out much too quickly.

These sizes of pots are prepared for seed sowing by selecting one piece of crock of about the same area as the bottom of the pot, and placing it squarely over the drainage hole **concave side down.** The crock is used to prevent compost from working down into the drainage hole and choking it.

The crock should then be covered with a small pad of rough organic matter such as sievings from the leaf mould or peat. Good gardeners shake out this "rough stuff" to remove fine material before using it. The purpose of the pad of rough stuff is to serve as a sort of crude filter to allow water to pass, but prevent fine compost from being washed down and choking the hole in the bottom of the pot.

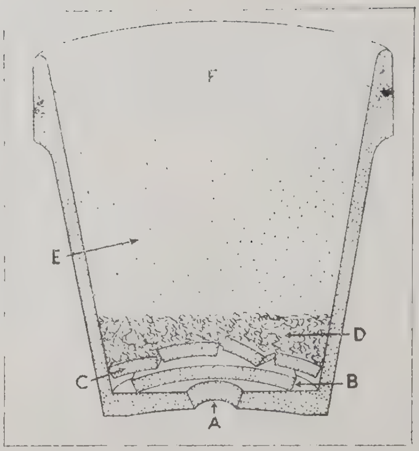
Finally, the pot is filled to overflowing with loose compost, struck off level, and the compost firmed down with a round presser, the bottom of another pot, or the fingers, to give a firm level surface on which to sow the seeds.

Preparing Boxes

To fill a seed tray, first put in a ½in. layer of the rough organic material. This is not essential, as it is for pots, but it does assist surplus water to drain away.

Next, loosely place compost into the box until it is above the level of the edge. Then strike the compost off level with a piece of board run across the edges of the box. The compost at the sides and corners of the box is then pressed firm by jabbing the fingers into it at close intervals all round the inside of the box. **This is an important operation, as loose soil at the edges and corners, where drying out is most rapid, always results in poor, uneven plants in these spots.**

Finally, press the soil down level with a wooden "presser" made of a convenient size for the boxes to be used. The amount of pressure to be applied can be learned only with practice, but should be enough to leave a firm surface without packing or glazing it.



Flower pot prepared for seed sowing. A—Hole for drainage. B—Main crock placed squarely over the drainage hole concave side down. C—A few smaller pieces of crock placed over the main crock (these are not needed in pots smaller than 5in.). D—Layer of "rough stuff" (sievings from leaf mould, etc.). E—The main body of soil, of uniform firmness throughout. F—Top of soil pressed level and firm at least ½in. below the top of the pot.

In each case the final level of the soil should be at least ½in. below the level of the pot or box to allow ample room for covering the seed and subsequent watering, and must be dead level. This is most important, as water will soak evenly into soil only if the surface is level, and an uneven surface may result in seeds being washed into the hollow places. After filling, the boxes or pots should be stood on a level surface and watered thoroughly with a can fitted with a rose about an hour before sowing the seed. This allows time for the soil to drain before sowing.

Sowing the Seeds

A high percentage of germination can be expected, as the conditions provided for seeds are as nearly ideal as possible. They should therefore be sown thinly. The actual spacing will depend, of course, on the size and speed of growth of the resulting seedlings, but from three to four seeds to the square inch in the case of larger seeds such as tomatoes to a score or so to the square inch in the case of smaller seeds is the ideal at which to aim—not an easy matter with very tiny seeds.

Some gardeners mix small seeds with a little dry sand and spread them with a salt shaker, and others sow by hand either direct from

the packet, or pinch by pinch from seeds held in the palm of the other hand. Whichever system is used the aim should be thin, uniform sowing. Thick sowing is the main reason for seedling diseases.

Normally only one variety of seed should be sown in a pot, but several may be sown in a box. When a box is used for sowing different varieties it should be subdivided by wedging pieces of cane across it on the surface of the soil to mark the limits of each sowing. Alternatively the seed may be sown in a series of shallow drills drawn across the surface of the box. Each subdivision should, of course, be labelled separately.

Although it may be satisfactory to sow several varieties of a flower in a box, it is better not to sow several different kinds of flowers in the same box, as some germinate much more quickly than others and removal of those which have grown first may disturb those which are not yet ready to be removed.

Covering the Seeds

After sowing the seed a very thin layer of soil should be sieved over the surface, **using a riddle not finer than ⅛in. because finer soil cakes badly.** Relatively-little soil is required for this covering. A layer ⅛in. thick is adequate for most seeds, but up to ¼in. can be allowed for larger seeds. It is not necessary to firm this fine layer although many gardeners press it down very gently with a presser.

The labels should now be inserted, but if the boxes are to be covered with paper, it is best to lay the labels on their edges alongside the inside edges of the box, supporting them with a match stick to prevent them falling over. They can then be put upright when the paper is removed.

[Photo News Ltd. photo.

Press compost firm at the sides and corners of the box by jabbing the fingers into it at close intervals.

Stand the boxes or pots perfectly level (some of the best gardeners even use a spirit level to check this), preferably on a bed of fine cinders or gravel, which will hold moisture. Boxes or pots stood directly on a wooden bench dry out too quickly.

Many gardeners advocate watering very gently with a fine rose "to settle the soil" after covering the seed, but this is not essential, especially if the boxes or pots were watered an hour or so before the seed was sown. Watering after covering the seed can lead to trouble if the compost tends to cake after watering. A caked surface prevents air from reaching the seeds in amounts sufficient for their needs and may result in very poor germination and growth.

For this reason the pots or boxes should be watered as little as possible between seed sowing and germination, but to provide the uniformly-moist conditions which the seeds require, they should be covered with glass, if available, to prevent the soil drying out, and this in turn covered with brown paper, which also shades the soil and reduces drying. If glass is not available, brown paper should be used by itself, and spread over the receptacles with ample overlaps to prevent the corners of boxes and the outside of pots from drying out.

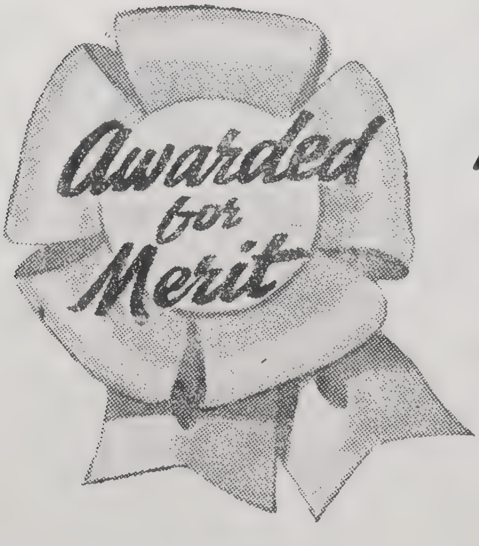
No watering at all should really be needed from sowing until just before the seedlings are pricked out. With seeds which germinate very slowly, however, it may be necessary to water from time to time before germination, using a fine rose. If this does cause the surface soil to cake, the soil surface should be scratched gently with a nail to crack the surface some time after watering.

The practice of dipping boxes and pans into water to half their depth and leaving them to take up water until the surface is moist does certainly avoid the caking of the soil that results from overhead watering, but it is apt to leave the bulk of the soil too wet, and is not recommended.

The boxes should be examined daily and the glass, if used, turned from time to time. As soon as the first signs of germinating seedlings can be seen the paper should be removed to give the young plants light. If the removal of the paper is delayed too long, even by 24 hours, and the weather is warm, the seedlings may be drawn, weakly, and especially liable to at-

[Jack Welsh and Sons photo.

Seeds may be sown directly from the packet, or pinch by pinch from seed held in one hand. The latter is the preferable method for the amateur grower.



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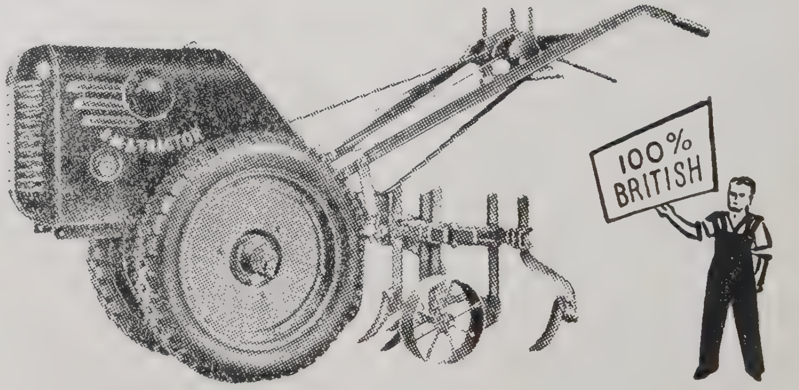

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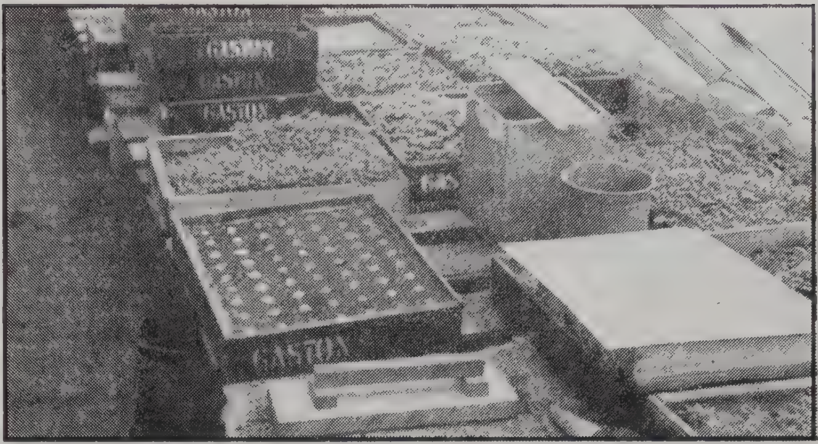
tack by damping-off disease. In dull weather the glass can be left on for another day or so, but should be removed if the sun is shining.

The slower-growing seedlings may require to be watered from time to time, and a can with a rose can be used, but the young plants do not take up a great deal of moisture from the soil at first and should not be over-watered. An overhead damping with the rose will often suffice.

PRICKING OUT SEEDLINGS

If a uniform batch of plants is to be produced when grown in boxes, each should be given exactly the same amount of room in which to develop. This can be achieved most easily by raising seedlings as already described and then transplanting them ("pricking out" or "pricking off") into other pots or boxes, giving each seedling the amount of room it will require for its proper development.

Although either boxes or pots may be used for raising seedlings, they are usually pricked out into boxes, except where they are to be potted up singly into pots.



[Jack Welsh and Sons photo.

The spaces for the seedlings have been marked in this box by fitting the perforated plate on the right over the box and rubbing a little sand through the holes. Note the uniform, level surface of the compost in the box, the presser (in front of the box), and the conical wooden dibbler beside it.

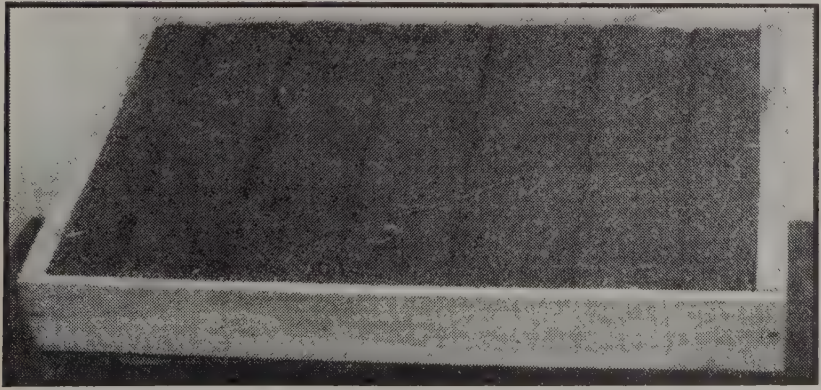
Early Pricking is Best

A great deal of attention has been paid at the John Innes Horticultural Institution to details of the pricking out process, and a most important discovery has been made. It has been shown quite conclusively that the best time to transplant seedlings is at the earliest possible stage at which they can conveniently be handled.

It might at first sight seem that very young plants would be less able to stand up to the shock of transplanting than older ones, but this is not so. Practically all a plant's food and water are taken from the soil by that part of the root lying just behind its tip. Most of the root tips are broken off when a well-developed seedling is lifted from the soil where it was grown, thus giving the plant a check from which it does not recover until new roots have grown. Moreover, there is a serious risk of diseases gaining entry through broken roots.

On the other hand a very small seedling can be lifted without damage to its root system, and this plant will grow away without a check if it is pricked out properly.

It is therefore recommended that seedlings should be pricked out as early as practicable, preferably when the first main root (the tap root, which grows out from the seed) is not more than ¾in. long and while only the "seed leaves" are showing. This may be within three or four days of the germination of quick-growing seedlings like tomatoes, or considerably longer for slow-growing ones, but will, in any case, be much earlier than has usually been the practice in the past. (Seeds of most garden plants have either one or two organs (cotyledons) within them which grow out of the seed and develop into "seed leaves" when the seed germinates. These are the first green leaves which appear above the ground. They are usually quite different in appearance from the mature leaves of the plant and are often of a much simpler shape. A few days after the seed leaves appear the first "true leaves" start to grow.)



A seed box prepared for sowing several varieties in separate drills drawn with a nail. Note the level surface of the soil, ½in. below the edge of the box. A perfectly level surface is essential for uniform watering.

Choice of Soil Mixture

The John Innes seed compost should be used for pricking out seedlings. It should be in correct potting condition, as shown by the hand-squeezing test.

Where seedlings are being grown in a glasshouse some growers make a point of putting the soil in the house for a day or two "to warm up" before using it for pricking out, but recent experimental work shows that this is not really necessary.

The boxes should be filled exactly as described for seed sowing, and the surface should be level and uniformly compressed. To ensure even spacing, which is important if uniform plants are to be produced, it is worth while to mark the positions where the seedlings are to be put.

Some growers have a board which will just fit into the top of the box and to which are fitted a series of short pegs. When the board is pressed into the soil and removed it leaves a hole in the soil in the place where each seedling is to be put.

Alternatively, a sheet of metal or strong cardboard can be drilled with holes at the proper places and used as a marker. The sheet is placed on the soil, a little sand or dry, powdered (sterilised) loam rubbed over the surface, and the sheet removed, leaving a little of the lighter-coloured material to mark the place for each seedling.

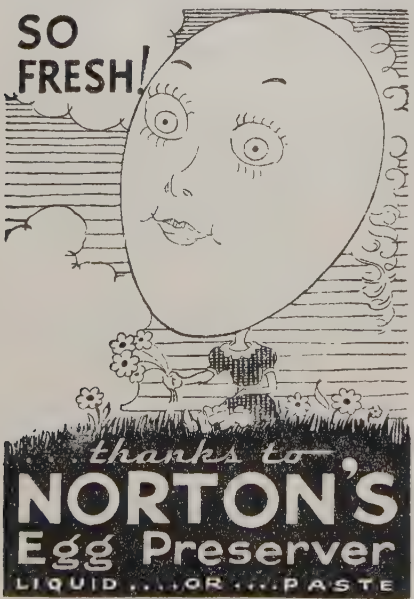
It is most important that the outer row of plants should not be too near the edge of the box, as this usually results in poor plants. The compost at the outer edges next to the wood tends to dry out more quickly than the rest of the soil, leading to checks and uneven growth in plants pricked out too near the wood.

Spacing of the seedlings depends on the vigour of the plants concerned. The most vigorous, for example, asters and calendulas, may be given up to 2in. apart each way. Plants of intermediate vigour (petunias, stocks, antirrhinums, and nemesias) may be put out 1¾in. apart, and those with least robust growth (primulas, lobelias, etc.) 1½in. apart. For general convenience, however, home gardeners are recommended to space all seedlings 1¾in. apart each way.

Pricking Out Into Boxes

The seedlings should be watered thoroughly several hours before they are to be pricked out. This has a marked effect in minimising damage to their roots as the seedlings are removed from the soil, and also ensures that they are well supplied with water when they are transplanted.

Seedlings should be lifted from the soil gently after it has been loosened with a knife or wooden label, and should be held delicately without squeezing or bruising the seed leaf or stem. Some careful growers overseas, even commercial growers, do not touch the plants by hand at all if they can avoid it, but prefer to lift them out with a wooden plant label in which a V-shaped slit has been cut. The seedlings are lifted by slipping the slit under their seed leaves.



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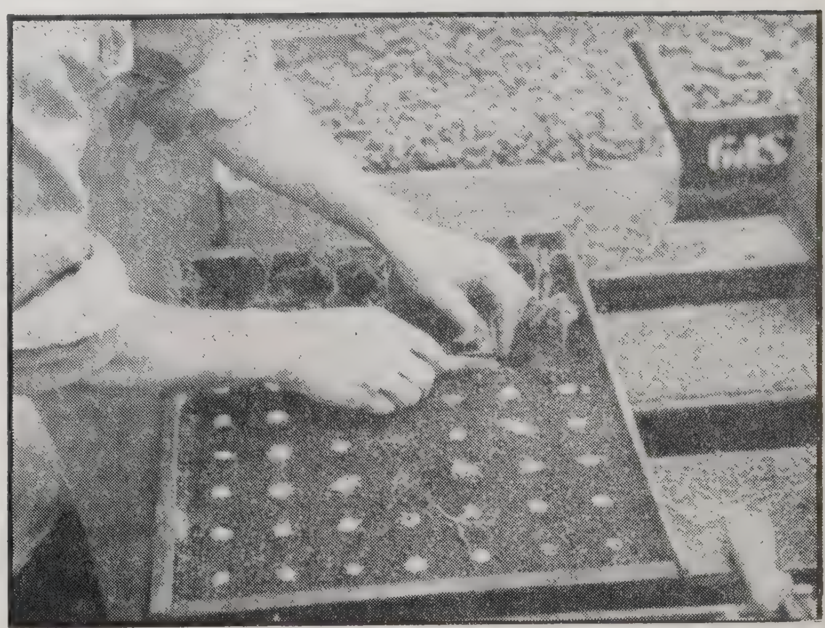


[Jack Welsh and Sons photo.

Pricking out seedling tomatoes. Recent experiments indicate that it is preferable to transplant seedlings at a much earlier stage than shown here. Note that the outside of seedlings is sited well inside the box and not near its edge.

This extreme care is not necessary with most of the plants home gardeners will want to raise, but gentle handling is essential. Bruises which may be quite invisible to the naked eye will invite damping-off and other seedling diseases.

A hole should be made for each seedling with a cone-shaped wooden dibbler deep enough to take the main root of the seedling. The seedling should then be lowered into place until the seed leaves are just above the general soil level, the main root being kept vertical. Finally, close the hole by pressing the soil gently to the root with the dibbler.

If for some reason the seedlings are not uniform (some seeds germinate irregularly) they should be more or less graded as they are pricked out, putting the largest seedlings in first and smaller ones later. If large and small seedlings are pricked out haphazardly, the larger ones will soon overshadow and crowd out the smaller ones.

When the box has been filled give it a sharp tap on the bench to leave a loose, even surface. Some growers now water lightly with a fine rose "to settle the soil;" others prefer not to water until later, contending there is ample moisture in the soil for the immediate needs of the plants if it is in correct potting condition when used.

There is much to be said for the latter method, provided the seedlings are pricked out very young, as recommended. Where seedlings are older they may wilt after transplanting and in this case an early sprinkling with water may help to prevent wilting by keeping the atmosphere around the plants moist.

The dreaded damping-off disease of seedlings, which causes the plants to topple over and die and which may rapidly decimate young seedlings, should not occur if proper care has been used in raising the plants.

Should the disease occur, however, all the boxes should be watered at once with Cheshunt compound. This is prepared by mixing 2 parts by weight of pulverised copper sulphate with 11 parts by weight of ammonium carbonate. The mixture is allowed to stand for at least 24 hours in a corked, glass bottle and is then made up by dissolving 1oz. of the mixture in a little hot water and then making up to 2 gallons with cold water. After being dissolved in the water it should be used as quickly as possible at the rate of 1 quart per square foot of surface.

POTTING YOUNG PLANTS

It may be decided that the young plants are to be grown in pots instead of boxes. Though this requires more care and is considerably more expensive, as pots are now costly to buy, it has the advantage that plants can be turned out of pots and planted with very little disturbance to their roots, whereas there is bound to be considerable mutilation of each plant's root system if it has to be lifted out of a box, where its roots will probably have spread for some distance through the soil.

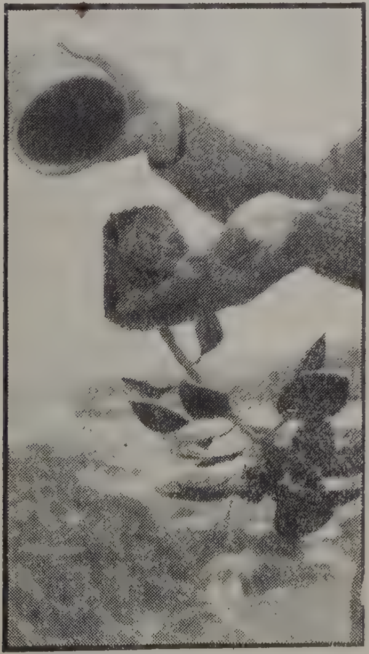
It takes time for a plant to recover from this check, and during the recovery period the plant ceases to develop. Where early results are important it is a decided advantage, therefore, to grow plants in pots and so avoid any check. This applies, for instance, to tomatoes. Plants grown correctly and planted out from pots will produce an earlier crop of fruit than plants set out from boxes.

Certain types of flowering plants seem actually to resent the check of being planted out from boxes. Zinnias, in particular, do best when the seedlings are grown on separately in pots instead of boxes.

Pots of 2½ to 3½in. sizes should be used for raising plants for planting out. Smaller pots are unsatisfactory, as they dry out much too quickly and larger ones are too expensive and uneconomical.

New pots should be soaked and old pots cleaned. One piece of crock should then be put concave side downward over the drainage hole in each pot and a very little rough material placed over the crock.

John Innes seed compost in correct potting condition should be used for potting seedlings. The John Innes potting composts are normally used only for plants grown in pots larger than 3½in. in diameter.



To turn a plant out of its pot put the fingers on the surface of the soil on either side of the stem, invert the pot, give it a sharp tap, and the pot can be lifted away freely.

Method of Potting

For potting, the right-handed gardener should have a pile of compost on the bench slightly to the right, the box of seedlings on his left, and a clear space on the bench in front of him.

A prepared pot is put on the clear space, a little soil put over the rough material and pressed down with the fingers, and the pot then filled loosely with compost level with the top. Next, make a hole in the centre of the soil with the right forefinger or a dibbler, lower the roots of the seedling into the hole with the left hand, and close the hole by pressing gently on the soil with the fingers of the right hand and then with the fingers of the left hand as they disengage the seedling. Finally, give the pot a sharp tap on the bench to leave a loose, level surface.

After potting, the seedlings should be exactly in the centre of the soil, there should be a ½in. space between the soil level and the rim of the pot to hold an adequate amount of water, the surface should be exactly level, and the compost should be reasonably firm and of even consistency throughout the pot (an occasional pot should be turned out after potting to see whether the work does, in fact, measure up to the last specification).

The bench on which the pot is stood must be kept free from compost. If a pot is stood on soil, the soil works into the drainage hole and may completely choke it, resulting in bad drainage and an unhealthy plant.

Watering

After potting, the pots should all be stood on a level surface, whether in the frame or glasshouse or outside, preferably on a layer of old cinders or gravel. Each pot should be perfectly level to enable it to be watered properly.

The same recommendation applies to the initial watering of pots as to boxes. It should not normally be necessary to water as soon as the seedlings are potted, although some growers do so.

Even more care is needed in subsequent watering of pots than of boxes, as pots naturally dry out much more quickly than boxes. The grower soon learns to judge whether or not the pots need watering from the feel of the soil surface, from lifting a pot to judge its weight, or, most usually, by tapping the pot. The soil in a pot shrinks slightly as it dries out. If the pot gives off a ringing note when tapped, it indicates that it needs water (as the soil has shrunk and drawn away from the side of the pot), whereas a dull, thudding note indicates that the soil is still moist and pressed tightly against the sides of the pot.

After potting, a plant should be exactly in the centre of the pot. The soil should be firm and level but with a slightly loose surface, and should be at least ½in. below the rim of the pot to allow ample room for watering.

When watering, sufficient water should be given to fill each pot. Damping the surface leads to an illusion that the soil is moist, whereas, in fact, the lower levels of compost inside the pots may be quite dry. Watering should be done with care, or soil may be washed out of the smaller sizes of pots and an uneven surface left.

Over-watering can do much harm to pot plants, but is more likely to occur in larger pots. There is little danger from over-watering in pots up to 3½in. size, as these pots usually drain quite freely and rapidly, provided the drainage hole does not become blocked.

Planting Out

When potted plants are planted out they are "turned out" of their pots by putting the fingers on the surface of the soil on either side of the stem, inverting the pot, and giving it a sharp tap; the ball of soil should slide freely out of the pot without breaking. If the ball of soil will not come out freely or without breaking, it is usually because the pot was not cleaned properly before being used. The roots adhere to hardened lumps of old soil on the sides of the pot and will be torn and damaged as the pot is turned out.

FROM SINGAPORE TO SUMATRA

British Nursing Sister in Japanese Internment Camp

THE day Pearl Harbour was bombed Japanese bombs fell on Kedah, the capital of Alorstar, the northernmost state in Malaya. In addition to possessing an airport, as befits a town of importance, Kedah was also an R.A.F. base, hence its priority on the list of Japanese targets. The attacking planes came over in waves, strewing such a wrack of death and destruction throughout the city that the inhabitants' only chance of survival lay in flight. Many of the local peasants piled their bedding and few odds and ends of belongings (including the family goat!) into their little "mosquito" buses and started south, but the planes swooped down and machine-gunned them as they fled. Workers in the outlying paddy-fields and men digging trenches near the hospital were likewise doomed, the folk who fared best being those heedful of the order, "Pergi ulu—go into the jungle," and remaining there without attempting to return to their ruined homes until all the bombers had gone.

Meanwhile the staff of the big Government hospital had done a magnificent job in evacuating the majority of their patients by lorry, even attending to such details as arranging for a trustworthy amah to look after a motherless baby, before they, too, joined in the general exodus. And such was their devotion over and beyond the call of duty that at the first possible opportunity two Indian doctors went back through the enemy lines to look after the mental cases whose condition precluded their being removed from the hospital with safety.

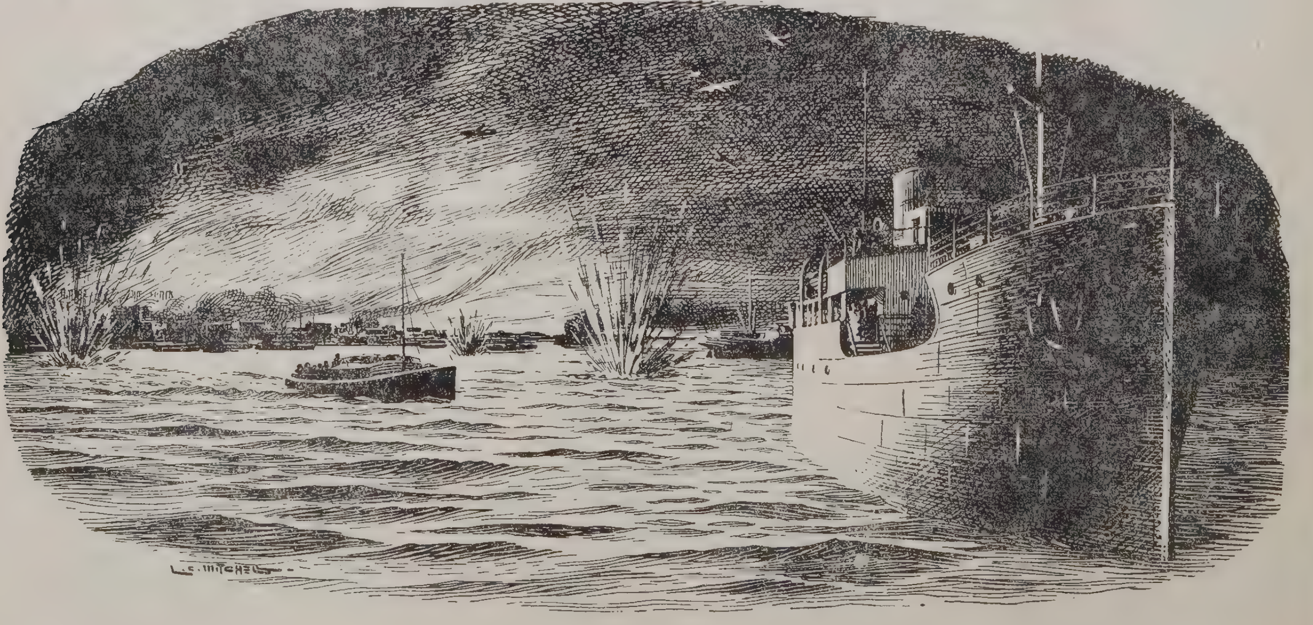
The road south was jammed with refugees, and the deserted towns with their blackened buildings and burnt-out cars and rickshaws bore grim testimony to the accuracy of the invaders' aerial attack. When the little band of nurses eventually reached Kuala Lumpur they linked up with the hospital there and after they had recovered somewhat from their perilous journey they volunteered to assist wherever needed.

Smiling, brown-eyed Phyllis Briggs, who had nursed in Kedah and other parts of the Federated Malay States, was among the last of the nurses to leave when Singapore fell. As the launch sped out to where a trio of ships waited in the roadstead the whole city appeared to be burning. No scene conjured up by Dante in his Inferno could have been half so spectacular as the sight of those leaping flames lighting the blackness of the sky. Amid bursts of shellfire they managed to board the Mata Hari, the "Eye of the Sun," who despite her romantic title was merely a cargo boat manned by a scratch crew collected from vessels which had been sunk, and with accommodation for 9 passengers only. Her passenger list totalled 320 when she sailed out of Singapore harbour that fateful night. It was a hair-raising trip, especially as the buoy marking the end of the minefields was never sighted and the captain could not be certain whether he was still in the danger area or not. Moreover, because of repeated bombing attacks, his orders were to hug the islands by day and sail at night. Under cover of darkness he was duly headed for Banka Straits when the green searchlight of the enemy played overhead, focusing on the hapless vessel until dawn revealed the proximity of an enemy destroyer. The Mata Hari's maximum speed being only 13 knots, and her sole means of defence an obsolete gun, the captain had no option but to surrender, and the passengers were taken to the nearest island and herded on to a narrow wooden jetty. All through the long, hot hours they were kept there without food or water, and when darkness came suddenly, as it always does in the Tropics, a cold wind blew up, adding to their discomfort as they huddled close together on the hard boards and tried to get what sleep they could.

It was nearly midway through the following day before they were lined up in threes and marched away to a camp at Muntok. Originally built for the coolies in the tin mines, it comprised a number of windowless stone huts with sleeping quarters consisting of raised concrete platforms sloping down toward a central passageway. Such spartan conditions coupled with inadequate food and lack of medical supplies contributed greatly to the high incidence of sickness, and in a few weeks, when the camp personnel was transferred elsewhere and a new batch of prisoners-of-war brought the masculine quota up to 500, Sister Briggs was one of the 23 women who remained behind to look after the sick and wounded.

Later the whole camp was removed to Sumatra, and after completing the journey upriver to Palembang the civilians were sent to the jail, the members of the forces joined their compatriots in other camps, and the nurses were billeted in the already-overcrowded houses of the Dutch internees. Sister Briggs had to share a small room with 7 other people and an outsize dog. The only furniture being a cupboard, the occupants had to sleep on the stone-flagged floor, and—horror of horrors for a member of the nursing profession and an Englishwoman to boot—with the door and windows shut! No wonder she found a sojourn in an adjacent garage more to her liking.

Chief item on the bill of fare was rice, watered down to a thin gruel for breakfast, and boiled for dinner and tea. Vege-



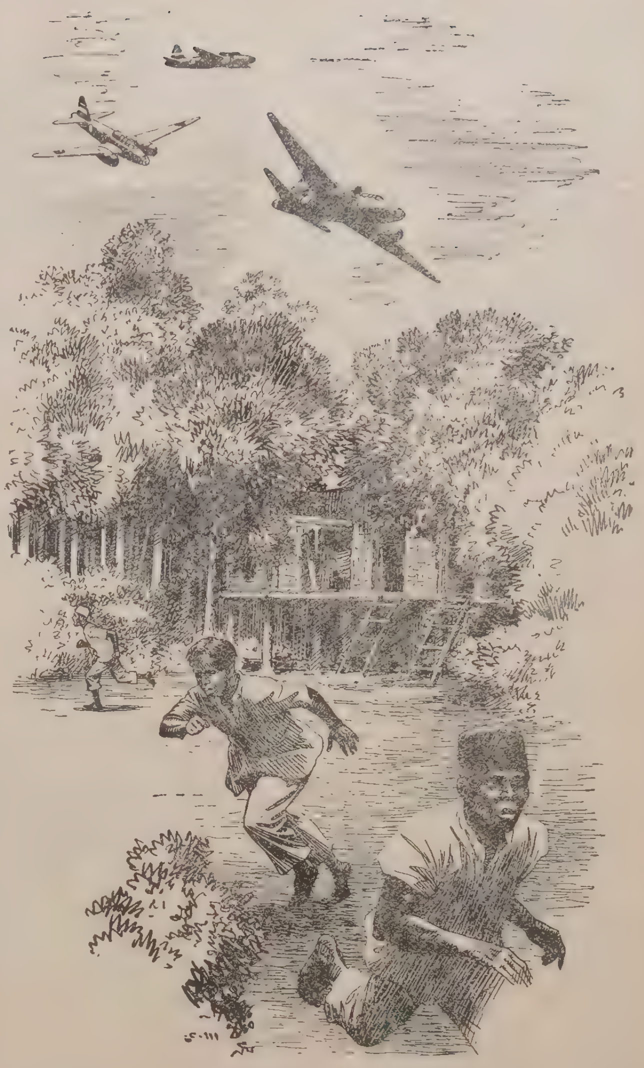
tables consisted mainly of kankong (a kind of water spinach which was as rich in iron as it was insipid in taste), sweet potatoes, and various gourds, the average ration being about 2 tablespoons per person per day. Edibles deteriorated rapidly in such a hot climate, yet the authorities often left carrots, beans, and Chinese cabbage in an open shed outside the compound till they were half-rotted before issuing them to the hungry prisoners.

Nothing was ever wasted; eggshells were crushed and consumed in lieu of calcium; fish bones were first simmered for soup, then dried in the sun and pounded to provide a piquant but rather gritty relish to relieve the monotony of plain boiled rice. Another piquant addition was red palm oil, a thick, reddish-orange liquid so rivalling cod-liver oil in its nutritive properties that it had figured regularly in the dietary of T.B. cases and delicate patients in the Kedah Hospital. All cooking in the camp was done on open fireplaces made from bricks or boulders plastered together with mud, and the charcoal resulting from these wood fires was carefully collected and ground into powder which sold at 10 cents a teaspoon. It could either be taken medicinally to cure stomach troubles or used as a dentifrice, the buyer's fingers serving as a toothbrush.

The same thriftiness was shown in regard to clothing. During the earlier stages of internment a local haberdasher was sometimes permitted to visit the guardhouse and display his wares. From him Sister Briggs purchased a white linen tea towel with a red border, and by folding it cornerwise she converted it into a pair of smart sun-tops. The two tiny triangles of material left over were cut into strips and joined to form a halter neck. Worn with blue shorts her garb was not only practical for such a climate, but sported a particularly patriotic note. From a man's shirt bought second-hand she contrived a playsuit for a little boy from the sleeves, and a sun-top for herself from the tails. The rest of the garment featured as part of her "best" rig for afternoons. As clothing supplies dwindled, prices rocketed accordingly, and that same shirt, after two years of wear, was considered good value by its new owner at a price far in excess of the original. Indeed, the clothes problem eventually became so acute that patchwork was the prevailing mode, and the dying bequeathed their scanty wardrobes to their friends. Needles were more precious than gold and worn-out garments were unravelled to provide sewing thread. Trompers came to be the universal form of footgear throughout the camp; they are best described as clogs with wooden soles shaped to the feet and about 1½in. high, and having a leather bar or piece of bicycle tyre for fastening. The straps, however, broke frequently and the scarcity of nails made repairs difficult.

Morale was maintained by community activities. There were concerts and country dances and classes for French conversation; people could improve their knowledge of Dutch or Malay, or take part in choral singing, or join the orchestra which, lacking instruments, hummed an accompaniment to the choir's part-songs. So the slow months passed till the internees were sent back to Muntok once more. Unfortunately, by this time most of them were suffering from beriberi and other unpleasant complaints and were too weak to take part in the occupations which had formerly been of such interest. Though this new camp was clean and airy, the dreaded scourge known as Muntok fever claimed many victims. The Japanese supplemented the meagre rice ration a little and duck eggs and coconuts made an occasional appearance, likewise fish, including small sharks, dried octopus—tough and rubbery—prawns, and once a giant stingray as big as a table top and requiring 4 men to lift it. Alarmed by the prolonged fever epidemic, the Japanese had the prisoners transported again, this time hundreds of miles away into the heart of Sumatra's jungle. That trip was the worst they had ever experienced and there were 7 deaths on the way.

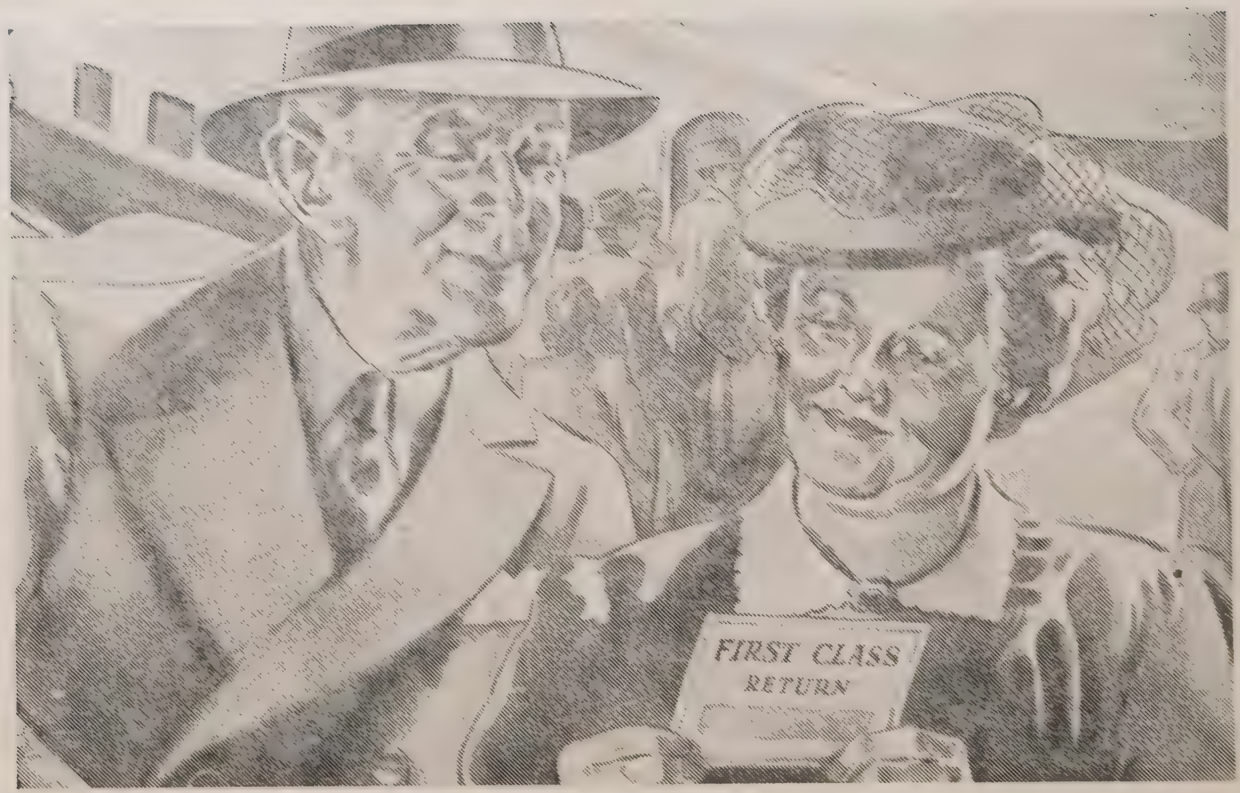
The women who survived were housed among rubber trees so tall that their tops shut out the sky; the men's camp was up on the hill. Ferns grew in profusion, their roots proving edible and nearly as appetising as asparagus, and gorgeous butterflies and dragonflies made rainbow splashes of colour in the green twilight of the jungle.



The scene among the trees six months later when Captain Saki stood on a table for a platform and announced to the assembled prisoners that the war was over had the strange, unreal quality of a dream. At first it was hard to believe that such good tidings could possibly be true, but when an Allied plane flew over without any gunfire from the enemy and cases of food parachuted down, they knew that victory had come at last and the joy found adequate expression. The Japanese promptly brought them supplies of tinned butter, material, and lipstick in a belated attempt to mitigate the effects of their privations. (It was during their stay in the jungle that Sister Briggs and her companions were glad to appease their hunger with monkey flesh and bear steaks.) Subsequently Allied planes dropped bread and newspapers, the first they had seen for over three years.

For the initial stage of her air journey back to civilisation Sister Briggs wore Japanese army issue boots, shirt and trousers, and carried her one and only dress in a haversack! Rest and treatment in Singapore Hospital enabled her to look a little less like a walking skeleton before she boarded the plane for New Zealand. She weighed only 5½ stone on entering hospital, but when I saw her in Wellington a few months later she had regained her normal weight of 9 stone. She was leaving for England the next day to see her family before returning to take up her work of mercy again in Malaya. Such is the indomitable spirit of the Sisters of the Colonial Nursing Service.

Mary



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3

"One-pot" dinners

Menus Adjusted to the Power Cuts

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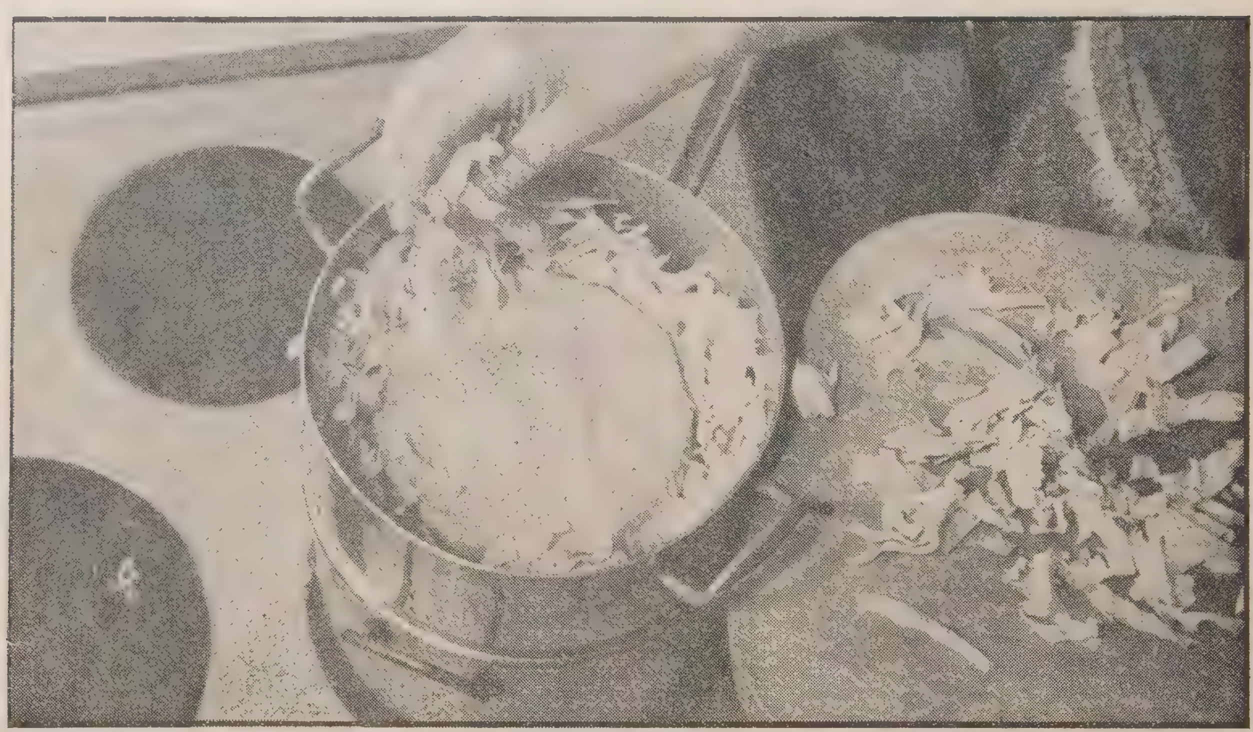


Putting the shredded cabbage round the ginger pudding for menu 1. Stuffed steak, potatoes, and pumpkin are in the saucepan under the steamer.

Menu 1

Stuffed steak.
Potatoes, pumpkin, shredded cabbage.
Steamed ginger pudding.

A saucepan, a steamer, and a pudding basin which will fit into the steamer are required. Cooking time will be about 2 hours.

Stuffed steak

- ¾ to 1lb. of "pocket" steak
- 1 dessertspoon of chopped parsley
- 1 to 2 teaspoons of lemon juice
- 1 tablespoon of melted dripping or chopped suet
- 1 cup of breadcrumbs
- Pinch of mixed herbs
- Salt
- Pepper
- Small rasher of bacon cut into fine strips
- Beaten egg or milk to bind

Chop the suet and parsley, blend them with the rest of the ingredients, and moisten the mixture with stock or milk or bind it with the beaten egg. Stuff the pocket, sew it up securely with fine twine or strong cotton, and dredge the steak thickly with flour. Melt a little dripping in the saucepan and brown the steak on both sides. Add a cup of boiling water or stock, then put on the steamer and lid.

Prepare the pudding and put it into the steamer. After an hour's cooking arrange prepared pumpkin and potatoes round the meat. Shred the cabbage and place it round the pudding basin in the steamer 20 to 30 minutes before serving the meat; cooking time for the cabbage will depend on the age and kind of cabbage.

Steamed Ginger Pudding

- 3oz. of dripping or finely-chopped suet
- 1 level teaspoon of baking powder
- 1 teaspoon of ground ginger
- 8oz. of flour
- 1 tablespoon of golden syrup
- Pinch of salt
- Milk to mix

Rub the fat into the flour, add the soda, salt, and ginger, and mix with syrup and milk to a dropping consistency. Turn the mixture into a greased basin and cover it with buttered greaseproof paper, pleated under the rim of the basin. Steam the pudding for 1¾ hours.

Menu 2

Curried sausages and vegetables.
Steamed potatoes, brussels sprouts.
Chocolate pudding.

For this dinner a large saucepan and steamer are the cooking utensils required. Preparation and cooking will not take more than an hour. The pudding is made first to be served cold, though it can be kept hot in the steamer with the vegetables. Alternatively, the hot pudding can be poured into a warmed basin and covered with a plate, then the ironing blanket or a thick rug folded around the basin to help conserve the heat.

Chocolate Pudding

- 1 pint of milk
- 1oz. of cornflour
- 1oz. of sugar
- 1 tablespoon of cocoa
- Vanilla essence

Mix the cornflour, sugar, and cocoa to a smooth paste with some of the cold milk. Bring the rest of the milk to the boil, add the cornflour mixture, stirring continually, and boil it until it is thick and cooked. Pour the pudding into a basin and cover it if it is to be served warm, or into a serving dish and set it aside to cool. Wash the saucepan and proceed with the meat and vegetable course.

Curried Sausages and Vegetables

- 1lb. of sausages
- 1 large cooking apple, unpared, cored, and chopped.
- 1 dessertspoon of raisins or sultanas
- 1 dessertspoon of curry powder
- 1 tablespoon of coconut
- 1 large onion, chopped
- 1 carrot, cubed.
- 1 piece of swede turnip, cubed
- ½oz. of dripping
- 1 dessertspoon of flour
- ½ pint of stock or water
- Salt to taste

Heat the dripping in the saucepan and brown the onion, apple, and sausages. Add the flour and curry powder, stirring them well into the fat. Add the stock gradually while stirring. Heat the curry until it is almost boiling and add all the remaining ingredients.

Set the steamer in place and put in the required number of potatoes; choose small or medium-size potatoes that will require less cooking time. Wash and prepare the brussels sprouts and put them into the steamer on one side or over the potatoes 10 to 15 minutes before serving; very large sprouts may take 15 minutes or a little longer to cook by steaming, but avoid over-cooking them.

Menu 3

Broth.
Boiled meat.
Potatoes, cauliflower.
Steamed apple pudding.

This menu is suitable for a larger family or will provide the greater part of the next day's dinner. A large saucepan and a steamer to fit tightly are required. The quantities given will make two dinners for three or four people.

Broth

½ teacup of dried peas
½ cup of pearl barley
Half a small cabbage
2 medium-size carrots
1 or 2 leeks
Thick piece of swede turnip
Parsley
2 quarts of water

Wash and soak the peas and barley overnight. Heat them in a saucepan with water. When they are almost boiling put in a piece of beef—1 to 1½lb. of a boiling cut. Wash all the vegetables very carefully. Shred the half cabbage and leeks, dice the swede and one carrot, and grate the other carrot. Put all the vegetables into the pot and boil them for two hours with salt and pepper to taste. Chop the parsley and set it aside to sprinkle into the plates when serving the broth.

Prepare the pudding and cook it in the steamer, placing potatoes round the basin ½ to ¾ hour before dinner time. Break the cauliflower into large sprigs and cook it in the broth for 10 to 20 minutes.

Apple Pudding

4oz. of breadcrumbs
4oz. of dripping
4oz. of apples (measured when peeled and cored)
1 tablespoon of sultanas
4oz. of flour
1 dessertspoon of peel
3oz. of sugar
1 flat teaspoon of baking powder
1 egg
Milk to mix

Chop the apples small. Rub the fat into the flour, combine it with the other dry ingredients, and mix them with beaten egg and milk. Turn the pudding into a greased basin, cover it, and cook it in the steamer over the broth and meat for 1½ to 2 hours.

Menu 4

Broth.
Cold beef, salad.
Dumplings.

Preparation and cooking time for this meal will be very short, so the garden or the sewing may benefit by the time saved. Make the dumplings and cook them in the steamer, putting a small cloth, scalded and well floured on the upper surface, in the bottom to prevent dough falling through to the broth.

Dumplings

1½oz. of dripping or grated suet
1 teaspoon of baking powder
5oz. of flour
Pinch of salt
Milk to mix

Mix all the dry ingredients and add enough milk to make a soft dough. Divide it into portions and shape them into dumplings. Roll them in flour and cook them in the steamer above the broth for 15 to 20 minutes.

The crumb custard for menu 5, in a deep oven-glass plate, cooking on top of the steamer of the vegetables and hot-pot.

Make a bowl salad, using lettuce, endive, watercress, or shredded heart of cabbage, onion to flavour, beetroot, celery, radishes, and other salad ingredients in season.

Heat the broth and add a plentiful supply of freshly-chopped parsley to each plate when serving.

The dumplings can be served with syrup or split open with a pat of butter in the crack and brown sugar to sprinkle over them.

Menu 5

Bacon hot-pot.
Spinach, leeks.
Crumb custard.

The utensils required are one large saucepan, a cake tin or basin for the hot-pot of a size to fit easily into the saucepan, and a deep enamel plate or pie plate which will rest on the top of the saucepan.

Bacon Hot-pot

1½lb. of potatoes cut into slices
2 medium-size onions, finely chopped
2 tablespoons of chopped parsley
4 to 6oz. of bacon
Pinch of thyme or sage
Salt and pepper
A little stock
Milk or water

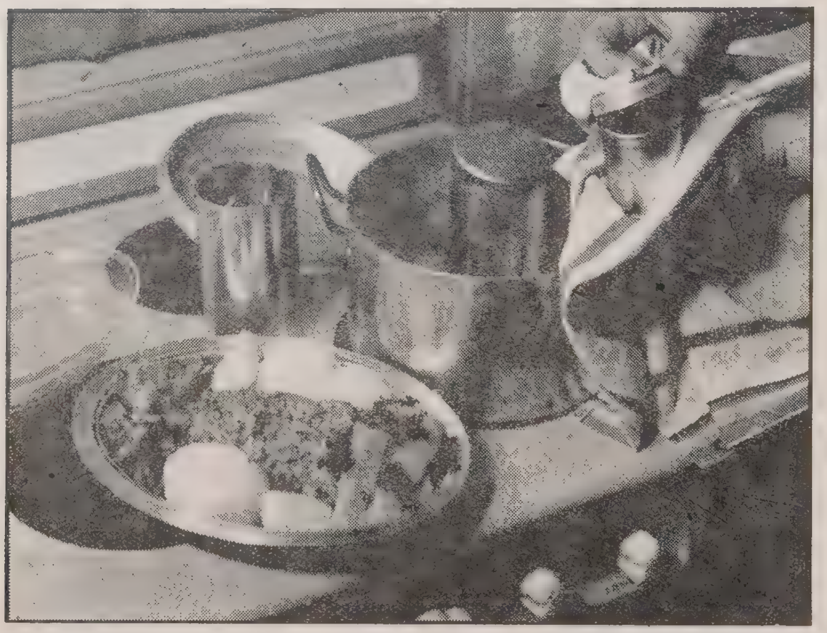
Grease the cake tin or basin, arrange in it slices of potatoes, onions, bacon cut small, herbs, and seasoning, and moisten them with stock or other liquid. Bottled or fresh tomatoes make a good addition to the hot-pot. Put a plate over the basin or cover it with greased paper. Set it in the saucepan with water to reach halfway up the basin and keep the water boiling for 1½ hours.

Put the prepared leeks into the salted water 20 to 30 minutes before serving dinner, and cook the spinach for only 10 to 15 minutes. The spinach can be placed on the plate covering the basin.

Crumb Custard

1 pint of milk
1 egg
1 cup of stale cake crumbs or soft bread crumbs
1 teaspoon of sugar
1 dessertspoon of butter
Vanilla
Nutmeg

Soak the crumbs in milk for ½ hour and add the sugar, beaten egg, and vanilla to taste. Stir them well. Grease a deep plate with the butter, pour in the custard, and grate nutmeg over the top. Set the custard over the saucepan and allow ¾ hour cooking time.



The meat roll and vegetables of menu 6, with gravy made in a separate tin.

Menu 6

Meat roll, gravy.
Carrots with parsley, brussels sprouts, potatoes.
Semolina pudding.

This dinner is suitable for two or three people, as the items are cooked in tins inside one large saucepan.

Meat Roll

½lb. of mince or ¼lb. of sausage meat and ¼lb. of mince
¼lb. of breadcrumbs
1 teaspoon of chopped parsley
1 onion, chopped fine
1 small teaspoon of mixed herbs
1 egg
Salt and pepper

Combine all the ingredients and bind them with the beaten egg. Turn the mixture into a well-greased tin, put on the lid, and steam it for 1 to 2 hours.

Semolina Pudding

3oz. of semolina
1 pint of milk
1 tablespoon of sugar
Grated lemon rind or a few drops of vanilla flavouring

Mix all the ingredients together, put them into a 1lb. cocoa tin, put the lid on, and steam the pudding for 2 hours. More semolina than usual for 1 pint of milk is required because there is no evaporation.

Make the meat roll and mix the pudding, putting them into two suitable tins. Stand them in a large saucepan with water halfway up the sides of the tins and keep the water boiling gently. Allow 2 hours for cooking. After an hour put the carrots, cut into chunks, round the tins and add salt to the water.

Mix 1oz. of flour and ½ pint of stock with a little meat or vegetable extract (for flavour and colour), salt, and pepper. Put them into a small tin and stand the tin in the saucepan. Half an hour before serving put potatoes round the tins in the saucepan and add the brussels sprouts ¼ hour later. Serve the carrots thickly sprinkled with 2 tablespoons of chopped parsley.

If the carrots are young, they will not take as long to cook and should be put into the water later so that they are not overdone.

Menu 7

Mutton stew with root vegetables.
Shredded cabbage.
Junket and prunes.

A saucepan with steamer and a basin to fit are the utensils needed.

Wash the prunes and soak them overnight in just sufficient water.

Mutton Stew

1½lb. of neck mutton
4 small onions
2 carrots
Piece of swede turnip
4 to 8 potatoes
1 pint of water
Pepper, salt, parsley

Cut the mutton into pieces and put it in the saucepan with the water, onions, carrot cut into thick slices, turnip cut into chunks, and half the potatoes cut into thick slices. Stew them gently for 2 hours, adding the rest of the potatoes, left whole, after 1 hour. Chop the parsley and add it immediately before serving the stew. Skim off any surplus fat during cooking.

Shred the cabbage and cook it in the steamer for the last 15 to 20 minutes before serving the dinner.

Junket and Prunes

Put 1 pint of milk into a basin in the steamer and allow it to reach blood heat. Remove it, add rennet, and sugar if liked, pour it into a serving dish, and put it aside to set.

Add sugar and a thin strip of lemon peel to the prunes, turn them into a basin, cover them with a plate, and cook them in the steamer. If the prunes have had long soaking, they do not require much cooking—just sufficient to dissolve the sugar. They can then be put into a serving dish and either allowed to cool or kept hot above the stew.

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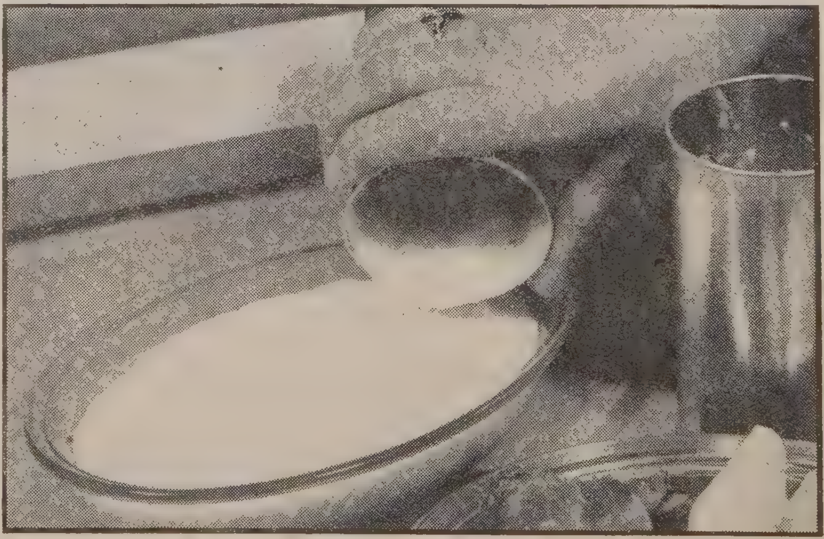


The semolina pudding is poured into a piedish, and the dinner in menu 6 is then ready to serve.

September is Seed-sowing Month in the Flower Garden

SEED SOWING is September's big task in the flower garden, where the foundation for the coming season's colour display is laid by sowing flower seeds outdoors and in boxes in the glasshouse. The correct way of sowing flower seeds in the open is described in this article by J. P. Hudson, Horticulturist, Wellington.

ANNUALS—plants which grow from seed, flower, and die all within one season—make a very important contribution each season to the colour in flower gardens and are especially useful in new gardens because they grow and bloom so quickly.

Types of Annuals

There are several types of annuals and several ways of growing them. The hardy annuals are sturdy plants which withstand frosty weather, especially when they are young. They are usually grown by sowing seeds in spring directly into the flower beds where they will flower through the summer, but another way of growing them is to sow seeds outdoors in the late summer. The young seedlings will not grow much during the winter, but will survive and flower in the following summer much earlier than those sown in the spring. By that means a longer succession of flowers can be obtained.

Pot marigolds (calendulas), cornflowers, clarkias, godetias, helichrysums (everlasting), Virginia stocks, sweet sultans, and love-in-the-mist are examples of hardy annuals.

Half-hardy annuals (often called bedding plants), such as petunias, antirrhinums, salvias (though these three are not true annuals), zinnias, French and African marigolds, viscarias, asters, nemesias, lobelias, and verbenas, need relatively high temperatures compared with the hardy annuals. Frost will kill them outright, and cool weather, even well above freezing point, will prevent them from growing while the low temperatures last. If sown outdoors in the cooler districts, therefore, these plants will not start to grow until the soil warms up in early summer, when it is too late for them to grow into big flowering plants before the autumn.

To give these annuals a good start and a long growing season they are sown in boxes under glass early in the season, pricked out, and hardened off in time to be planted out in the early summer when the risk of late frosts is past. The method of raising bedding plants in this way is described in detail in an article elsewhere in this issue.

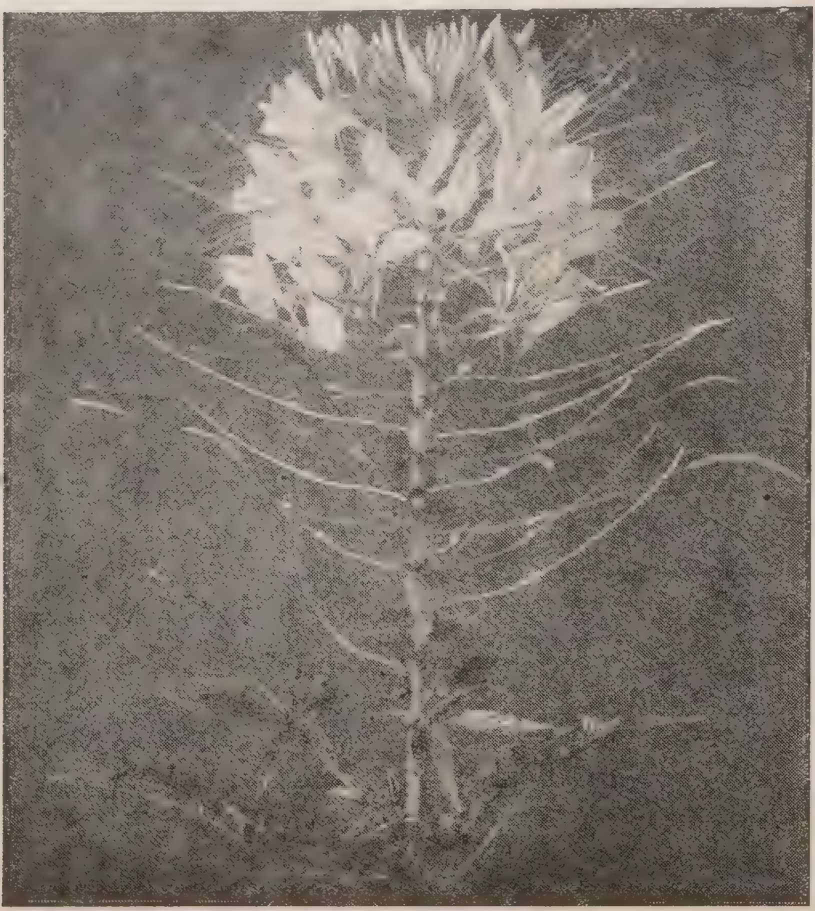
The distinction between hardy and half-hardy annuals is not clear cut. In the milder districts, where frosts do not occur, it loses much of its meaning, while nurserymen often raise hardy annuals in boxes and offer them as bedding plants.

Sowing Seeds Outdoors

Hardy annuals of all kinds may be sown outdoors in September in all but the coldest districts if the soil is in satisfactory condition. That can best be judged by stepping on the ground a few times.

HEADING PHOTOGRAPH

Polyanthus are best lifted, divided, and replanted each year in November or December as soon as they have finished flowering. The plants with the best flowers and choicest colours should now be marked with sticks or labels so that they can be used later for propagating next year's stocks.



[Douglas Elliott photo.

Cleome spinosa (Pink Queen) is a recently-introduced hardy annual with light pink flowers that created considerable interest last year.

[Photo News Ltd. photo.

The annual sweet alyssum (Lilac Queen) flowers for months if cut back occasionally to remove old straggling growth.

If soil picks up badly on the boots, the ground is still too wet for seed sowing, but if the soil does not pick up, seeds can be sown.

Before sowing annuals wait until clods on the bed are beginning to whiten, which indicates the first stage in their drying out. The bed should then be carefully prepared by forking or hoeing shallowly, especially if the surface is dry and powdery, then treading it to ensure a firm seed-bed, and finally raking it over to remove stones, break down small lumps, and make the whole surface level and even in texture. The raking should be done carefully, as small seeds will not germinate regularly in uneven, lumpy ground. If the soil cannot readily be brought to a fine tilth by raking, the operation should be put off for a few days until it can.

The seeds should then be sown thinly. One or at most two seeds to the square inch are ample; thicker sowing is both harmful and wasteful. Cover them lightly with soil, either by riddling a little dry earth over the bed or by raking the surface gently. Small seeds will not grow if they are covered with a thick layer of earth. A depth of soil equal to six times the diameter of the seed is a good general guide in sowing all seeds.

Some Reliable Annuals

The number of hardy annuals offered now is almost bewildering, and most gardeners try a few new ones each year. The old, well-tried favourites should also be grown, however, as they can be relied on to give a good return.

For instance, there are few garden plants which will give as long or bright a display of colour as the old-fashioned pot marigold, of which there are several named varieties in lemon and orange colours. Each plant of pot marigold will flower for months if the old flower heads are picked off regularly as soon as the petals fade.

Cornflowers, in blue and pink shades, also bloom reliably, and the lilac alyssum succeeds in almost any situation and flowers all through the season if cut back or thinned out every month or two to remove a proportion of the developing seed pods.

Nasturtiums are bright and cheerful, but are so likely to become carriers from which the spotted wilt disease can attack a wide variety of other plants that careful gardeners will not grow nasturtiums any more.

Garden Work for September

Asparagus "fern" (not a true fern at all, but a close relative of the vegetable asparagus) makes a useful pot plant for the house, where it will grow quite well in windows facing south, as it does not require direct

Orange and yellow pot marigolds (calendulas) are among the showiest flowers for cutting. The first few flowers on each plant have more substance than later flowers and are best for cutting. They should be cut with as long stalks as possible, even though that involves the sacrifice of some of the unopened flowers.

sunlight. There are two common sorts of "fern," *Asparagus plumosus* with finely-divided, feathery foliage, and *A. sprengeri* with rather coarser foliage. Both can be raised from seed sown now in a pot in a glasshouse or on a windowsill, or small plants can be bought from the nurseryman and potted up. They will last for years.

Bedding plants may be planted out from boxes in very early frost-free districts, but in most places it is better to delay planting, at least of the half-hardy types such as nemesias, salvias, and petunias, until the end of September or even October.

Begonia corms, boxed up and started into growth earlier in the season, should now be growing strongly and producing new shoots. A proportion of these can be cut off with a razor blade when they are 3 to 4in. long to make cuttings which will root freely in a warm glasshouse. The rooted corms, with at least one shoot on each, should be potted up into separate pots, using the John Innes potting compost.

Border plants, such as gaillardias, violas, pansies, and sweet Williams, can be planted out from boxes, but it is better to treat most of these as biennials, planting them in the autumn to become thoroughly established and flower in the following season.

Catmint (*Nepeta mussini*) flowers for months and makes a most satisfactory plant for edging a border or clothing and softening the hard edge of a concrete path. However, it becomes straggly with age and should be clipped hard with shears every spring, cutting each plant back to an inch or two from the ground. Numerous new shoots will be produced to bear this season's flowers. Pieces a few inches long, cut from the ends of the trimmings, will root readily in a cold frame.

Chrysanthemum propagation should continue, cuttings of the early-flowering varieties being taken. Cuttings rooted earlier are best transplanted 4in. apart in a frame or into seed boxes to develop sturdy plants with a bushy root system for planting out later. Water them sparingly, as rapid growth is not required at this stage.

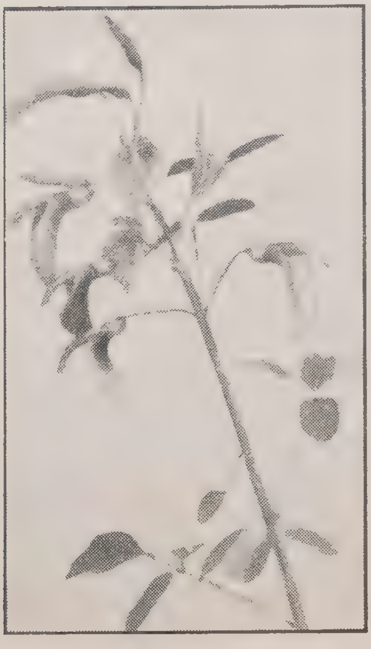
Dahlia tubers lifted last autumn and stored for the winter should be taken into a frame or glasshouse in August or early September with a little damp ashes, leaves, or soil packed round the sides but not over the tops of the tubers. Water them lightly to start them into growth and produce shoots which will make ideal cuttings that can easily be rooted as described in detail in the "Journal" for March, 1947.

Gladiolus corms are usually planted in September or October for the

Miniature Garden in an Old Sink

[*Photo News Ltd. photo.*

An old sink can be made into a most attractive garden ornament. Make a wooden stand for the sink, into the lower third of which place broken stone with small stones and gravel packed well between the larger ones. Fill the rest of the sink with good garden soil, preferably with a proportion of gritty sand added, and embed one or two well-weathered stones in the surface of the soil. When ready for planting the surface of the soil should be raised in a slight mound in the middle. Plant with as wide a range of cacti as possible and also a few trailing succulents, such as sedums, around the edge to clothe the side of the sink. No further attention will be needed, except for occasional weeding and a soaking of water two or three times during hot, dry spells in summer, when the cacti are growing strongly. The best way to soak the whole garden is to make one or two holes deep into the soil with a poker and pour in water until it runs out of the open plug hole of the sink.



The coral tree *(Erythrina crista-galli)* flowers in summer on the ends of new shoots. These trees should be pruned hard in early spring to ensure ample strong new growths.

main summer display, though a few corms should be saved for later planting to prolong the flowering season. Plant large corms up to 6in. below the surface in deep, light, well-drained soil, but corms of the same size should not be put deeper than 2 or 3in. in heavier, shallow soil. Small corms may be planted from 1½ to 3in. deep according to the nature of the soil. Corms should be spaced not less than 6 to 8in. apart if planted in clumps or in rows. Rows should be at least 2ft. apart.

Hydrangeas should be given a topdressing of two or three handfuls of blood and bone, scattered on the surface for a few feet around each bush and the surface of the soil then lightly pricked over with a fork without injuring the roots which lie near the surface.

Lawns will now be starting to grow. They should be thoroughly brushed before being mown to remove any small stones which may injure the mowing machine. If a roller is available, it is wise to roll the lawn before mowing, provided the ground is not too damp.

If water can be seen squeezing out of the lawn as the roller passes over it, the ground is too wet and the roller is doing more harm than good.

Lawns are best sown in autumn. They may be sown in spring, but poor results are likely if a hot, dry summer follows. The best mixture of seed consists of two parts of New Zealand chewings fescue and 1 part of Government Certified browntop, sown evenly at the rate of at least 1oz. of the mixture a square yard.

Michaelmas daisies (perennial asters) produce the finest heads of flowers if the plants are lifted and divided when the first shoots are seen and individual shoots are replanted at least 9 to 12in. apart. Each stem will then be furnished with a large, symmetrical head of well-developed flowers.

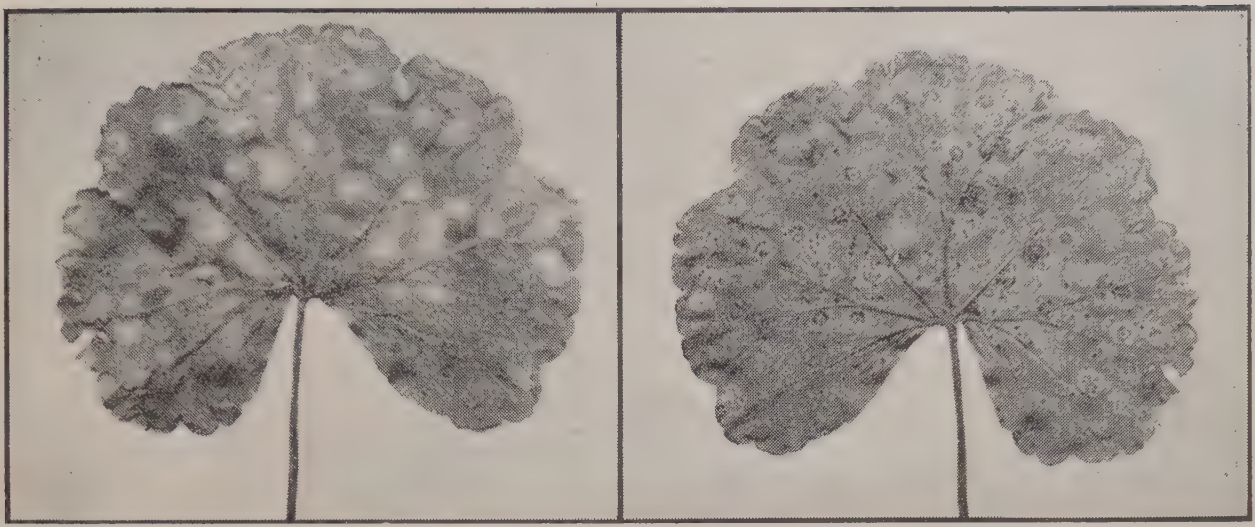
Rhododendrons, camellias, azaleas, and other shrubs with shallow, fibrous roots should be given a topdressing or mulch of well-rotted compost, spread on the soil around and under the bushes, to prevent the soil from drying and the roots being damaged in the heat of the summer. Many gardeners, especially on heavy clay soils, are finding that sawdust makes a satisfactory mulch; *Pinus radiata (insignis)* is the best type of sawdust for this purpose.

Rose pruning, as described in last month's "Journal," should now be completed in late districts. Collect all prunings and burn them, as several rose diseases may be carried over from year to year in infected branches. The surface of the bed should then be forked over lightly but carefully, making a special effort to bury any of last year's leaves which may be still lying on the ground, as they, too, can serve as a source of disease infection. The

[Photo News Ltd. photo.

Catmint makes a good edging plant if trimmed hard with the shears in September each year to keep the plants neat and encourage new growth.

GERANIUM RUST



The symptoms of geranium rust are conspicuous. Bright yellow circular patches show on the upper surface of the leaf (left), and small, dusty, dark brown spots on the underneath (right) correspond with the yellow patches on top.

fork should not be pushed far into the ground for fear of damaging roots which lie near the surface. A generous topdressing of animal manure, compost, or leaf mould should then be spread over the surface to prevent the soil from drying out and cracking later in the season, and to maintain the humus content.

Shrubs of yellow Spanish broom (*Spartium junceum*) become straggly if not pruned by being cut fairly hard in September, when last season's growths should be cut back to within a few inches of the previous year's wood.

Sweet peas are best sown in autumn, as described in previous issues, so that they are established and make early growth in the spring. However, seeds may still be sown where this was not done or to provide late flowers. Seeds should be sown an inch or two apart where they are to be grown and the seedlings thinned out to about 4in. apart when they are growing strongly. In very cold districts, where plants have been raised in boxes, they should now be planted out.

Violas are best propagated by cuttings in the late summer, but if this was not done last season, old straggling plants may now be lifted, the long stems cut off, and each plant pulled into three or four pieces. These can be planted back again after the site has been dug over and dressed with compost and the "complete flower border fertiliser" (see March, 1947, "Journal").

Reminders About Common Troubles

Chrysanthemum eelworms, which cause the leaves to die prematurely, spread by swimming up the stems in damp weather. Various authorities have suggested that the upward movement of the eelworm could be prevented by smearing a ½in. ring of petroleum jelly or grease-banding material around the stem a few inches above ground level. A Christchurch reader, who tried this method last year using petroleum jelly, has reported that the area of stems coated with petroleum jelly died, killing the upper parts of the plants. Examination of specimens confirmed that the banding seemed to have had a damaging effect on the plants. The whole question is being looked into by the Director of the Plant Diseases Division, Department of Scientific and Industrial Research.

Meanwhile gardeners are urged not to band chrysanthemums with petroleum jelly. Other more efficient ways of controlling chrysanthemum eelworm were described in last month's "Journal."

Geranium rust occurs very commonly on garden geraniums (zonal pelargoniums), causing bright yellow, circular areas which show up clearly on the upper surfaces of the leaves. Below each yellow area one or more brown, powdery blisters occur, each producing myriads of spores which blow about and spread the disease. Almost all the leaves may fall from badly-affected plants, which consequently are much reduced in vigour. This disease can be controlled by the following method. The trouble involved will be well repaid by the much-increased vigour and more satisfactory flowering of healthy plants.

The first step in the "cure" is to remove, in early spring, every leaf which shows signs of rust. The leaves should be put into a tin or bag, taken away, and burned. With badly-infected plants the simplest way of removing all diseased leaves is to cut the plants back fairly hard, collect the prunings, and hand pick the infected leaves which are still left on the plants. At the same time any dead, dried geranium leaves on the plants or on the ground should be collected and burned, as rust can spread from dead leaves which were infected.

The plants should then be sprayed thoroughly with a mixture of 2 fluid ounces of lime sulphur and ½ fluid ounce of colloidal sulphur (both obtainable from seedsmen) to 2 gallons of water. One tablespoonful=1 fluid ounce. Two weeks later the plants should again be inspected carefully, any young leaves showing rust spots removed, and the plants sprayed as before. That should be repeated at fortnightly intervals until no more leaves are found with rust, after which spraying may cease, but the routine fortnightly inspection and spraying should be restarted if infected leaves are found subsequently.

Geraniums growing on the walls of a house or by any painted woodwork should not be sprayed, as sulphur sprays will ruin paints.

Acknowledgement is made to the Director of the Plant Diseases Division, Department of Scientific and Industrial Research, for information about geranium rust.

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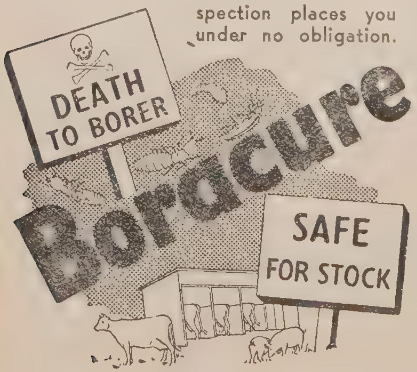

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- **It is estimated that in Great Britain, of 100 children born and *not immunised* 10 will contract diphtheria and one will die; of every 100 *immunised* one will contract a mild form of diphtheria and death is extremely rare.**
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IMMUNISATION IS FREE TO EVERY CHILD IN NEW ZEALAND

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Keep this announcement for future reference.

22.e

DOUBLE-PURPOSE ROOMS

By NORMA K. METSON, *Rural Sociologist, Wellington.*

WITH space at a premium as it necessarily is in all small homes, rooms must be designed for maximum use. The days when pantry, scullery, stillroom, servery, and numerous storerooms clustered round an immense kitchen, and when almost every household act and hour of the day were dignified by a separate room, are gone. In fact, one writer recently expressed the fear that, with present-day ideas of "open planning," we might be returning to a state comparable to the medieval house, where all activities centred in one room and privacy was unknown.

IN old houses, with rooms no more than four walls, ceiling, and floor, allocation was somewhat haphazard; the kitchen had to be where the stove was, but that might be the only fixed point. Adaptation to more up-to-date ideas may therefore require only a certain ruthlessness in removing partitions, building in storage space, and adding windows. In a house where bedrooms and living rooms are clearly separated, choice of furniture will be the deciding factor. In a new house, careful initial planning will take care of the family's requirements if they have considered thoroughly how each room can be made to yield maximum "livability."

When planning double-duty rooms certain general points must be kept in mind, so these will be mentioned before a more detailed discussion of room combinations.

The first essential is plenty of storage space, built in if possible, but if not, of the type which is non-committal—providing drawers, shelves, or cupboards, but not irrevocably a dressing table, desk, or bookcase. Built-in cupboards and drawers are to be preferred because, though they reduce floor space, they do not create the cramped effect of a small room with large pieces of furniture.

If a small area of floor space is to serve many different purposes, it is most important that things not needed at any particular time should be stored out of the way. But this storage must be convenient, or things will just not be put away and confusion will become even worse.

The second essential is adaptable furniture. Examples are chairs which are light and easily moved, suitable for dining, but comfortable enough to accommodate extra guests round the fire; or sturdy card tables, two of which will provide a dining table for a small party, then fold away for storage in a cupboard or against the wall when not in use.

Thirdly, the decorations must be durable, with fabrics and finishes which will stand up to day-long wear. Delicate colours and highly-polished woods which might be possible in a sitting or dining room used for rare formal occasions will not survive the small boys, cats, coal-carrying, and crumbs which are inevitably a part of family life. Nor should violent and conflicting patterns and colours be used in such a room. They become wearisome when seen

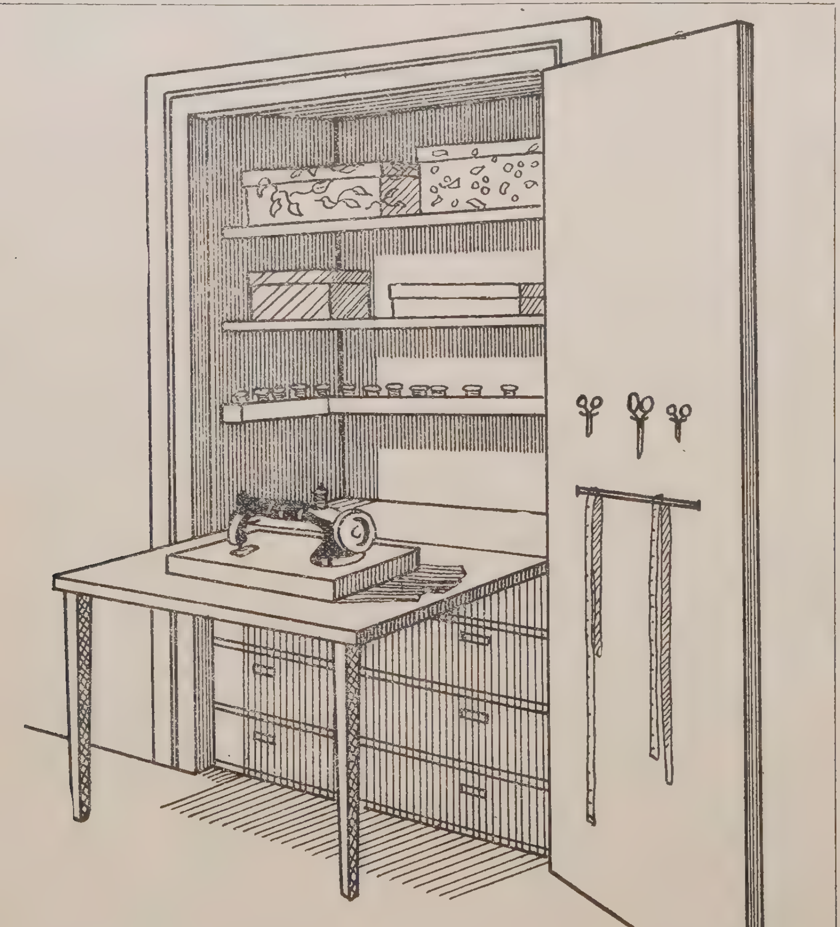
oo often, and too much contrast de-
troys the desired effect of space and
estfulness.

That effect can be gained in quite
mall rooms in various well-known
vays—by having woodwork and struc-
ural features the same colour as the
valls, a minimum of openings and in-
erruptions in walls and windows (no
usy chequer boarding of wallboard
ivisions or diamond-paned glass), and
urniture which is small in scale for
xample, with a light wooden frame
nstead of a heavy padded one, or no
ootboard and only a small headboard
n the bed instead of two high fences.
A large plain mirror above the fire-
lace or opposite the windows also
elps, as will a group of smaller
nirrors, which is much more effective
han having them dotted at intervals
ound the room and solves that prob-
em of duplicated wedding presents.

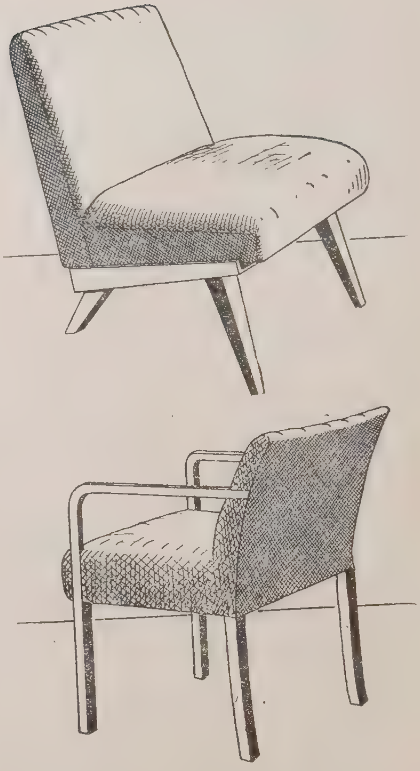
Kitchen Combinations

The kitchen — the most important
oom in a farm home—may be planned to include facilities for dining, living, sewing, or laundry, in addition to its usual functions of food preparation and storage. A long, narrow room is easiest to arrange for a double-purpose kitchen. The work area can then be placed at one end in a convenient L or U shape, and the doors, meal table, and children's play space will be handy but out of the way at the other end of the room. A room measuring 11ft. by 18ft. or 9ft. 6in. by 20ft. will allow such an arrangement if an electric stove is used; rather more room is necessary for a fuel range and wood-box.

If a greater degree of separation is desired for the work area, a partition of cupboards reaching part or all of the way to the ceiling can be built, giving almost the privacy of a separate dining room. An angle arrangement can also be used with working space in one arm and dining space in the other, but that will be economical only if the L shape fits in well with the rest of the house plan.



A sewing cupboard which can be built into a wall.



Adaptable types of chair.

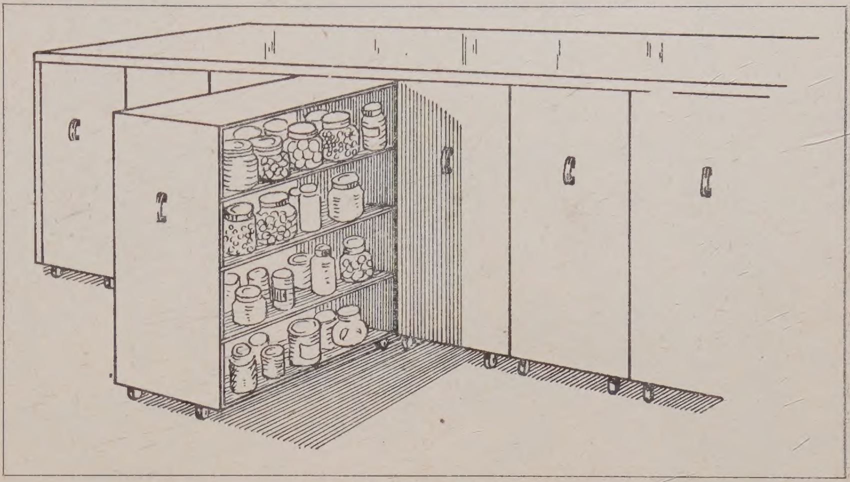
A combined laundry and kitchen is not widely favoured in New Zealand homes; usually laundry and bathroom are put together if such an arrangement is necessary. However, some new English designs feature a purely working kitchen, with no provision for meals or living space, in which a laundry tub is incorporated in the sink bench, the wringer folds back into the wall above, and the washing machine or copper takes its place in the sequence of kitchen cabinets. The objectionable steaminess of boiling clothes—the main reason for a separate laundry—is overcome by the new enclosed automatic washing machines.

Laundry and Bathroom

The laundry need not be waste space on all but wash days; it can be planned as one of the most useful areas of the house. Provide wash basin, lavatory, and a place for coats and boots; or concentrate on storage space so that surplus bottled fruit, preserved eggs, garden supplies, large toys, and old clothes have a place of their own; or keep rougher uses out, but add facilities for sewing and ironing, so that everything is at hand for doing the mending and the iron is just there when wanted for pressing seams.

Most bathrooms are too small and too frequently occupied to give much scope for more intensive utilisation. But there may be space for cupboards round the basin, or at an end of the

DOUBLE-PURPOSE ROOMS



Storage for bottled fruit.

bath, and in old houses, where the bath is sometimes in quite a large room, one end can be turned into a dressing room.

Dining, Living, and Sitting Rooms

Not many homes today can afford the luxury of a separate dining room. In fact, it has rarely existed in New Zealand, the "dining room" having almost always tended to become the every-day living room, with the sitting room kept for occasional entertaining.

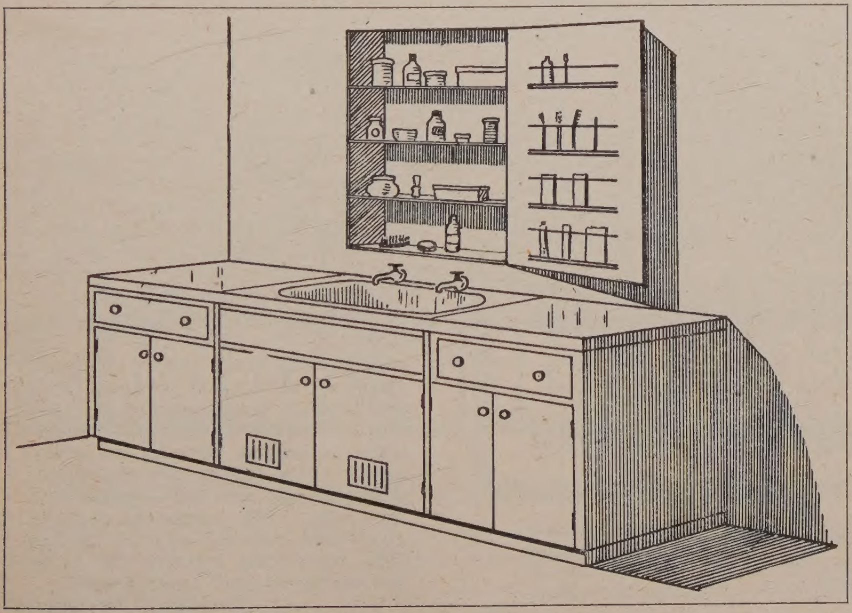
The modern trend is to combine these two rooms into one larger one and have a movable or incomplete partition dividing the two ends. If the dining room is kept, a better division of labour might be to use it for quieter occupations—study and office, sewing, or as an emergency bedroom—and to make the other a "living" rather than a "sitting" room.

Versatile Bedrooms

If there is only one living room for the family, it will certainly be fully used, and attention must be directed toward taking some activities out of it rather than introducing new ones. And the only place to which they can be taken is the bedrooms. The old-fashioned bedroom, with its large bed, wardrobe, dressing table, and wash-stand, was certainly not a place suitable for anything but sleeping and dressing, and this prejudice against making more use of bedrooms remains in spite of the fact that they are now the only rooms of the house where privacy and quiet, essentials for personal happiness, can be obtained.

The built-in wardrobe and the bathroom leave space for other uses, beds can be comfortable couches — they needn't look like beds in the daytime—and a dressing table can be quite efficient without proclaiming its uses to all the world. If Mother and Father have two comfortable chairs, they can sit in them and relax when the children want the living room for a party of friends. Children's rooms need a table and bookcase for homework, a bed which can be sat on without dire results, and again the bed-sitting room atmosphere. If children prefer to sleep as nearly outdoors as possible on a sunporch or veranda, it may be practicable to turn one room indoors into their own private sitting room, hobby room, or whatever they want most.

Spare bedrooms, like dining rooms, are becoming a luxury, but it is possible to evolve a den, sewing room, or study which, without too much trouble, can be turned over to accommodate one or two guests. With little extra expense an attic can provide space for storage, children, or emergency accommodation.



A built-in bathroom basin.

An Elizabethan Poet

My mind to me a kingdom is,
Such perfect joy therein I find,
That it excels all other bliss
The world affords or grows by kind:
Though much I want which most would have,
Yet still my mind forbids to crave.
I laugh not at another's loss,
I grudge not at another's gain;
No worldly waves my mind can toss,
My state at one still doth remain.
I fear no foe, I fawn no friend,
I loathe not life, nor dread no end.

—Sir Edward Dyer (in Elizabeth's reign).

This old Elizabethan gave us a counsel of perfection and he, like us, lived in troublous times. One admires particularly his freedom from covetousness and his sturdy independence: "I fear no foe, I fawn no friend." He was, as Martin Tupper says, "wealthy because he was affluent in soul." Life had not been too hard for him to cope with and Death to him would come as a friend. He possessed the "jewel called Content" in his heart and did not grudge others their greater share of this world's goods.

—"Hannah," Hastings.

Climb the mountains and get their good tidings. Nature's peace will flow into you as sunshine flows into trees. The winds will blow their own freshness into you, and the storms their energy, while cares will drop away from you like the leaves of autumn.

—John Muir.

Whooping Cough

WHOOPING cough is a distressing and dangerous disease, and is most fatal in the first year of life, states an officer of the Department of Health. Every year there are cases of scarlet fever, and many more cases of measles, but whooping cough is by far the most fatal of these three diseases. An effective method of prevention would dispel much misery and bring about a significant saving of child life, but it cannot yet be said that there is an effective method of inoculation against whooping cough, such as can be produced for immunisation against diphtheria.

The reason is that basically the two diseases are different in their attack. To anticipate a possible attack of diphtheria one can be injected with an anti-toxin developed fairly easily, because of the simpler nature of diphtheria toxin, which is part of the disease. But it is not by any means as easy to develop from the bacillus of whooping cough a serum which will either prevent attacks or reduce their violence. For many years efforts have been made by doctors in Britain, America, and Canada with injections which it was hoped would produce some definite results in this direction.

However, a careful examination of the circumstances in which the tests were made has suggested that the necessary qualification of "all things being equal" as between the control groups and the injected groups did not always apply. To arrive at a solution to such a problem it is necessary for the injected children and the non-injected children to be normally exposed to the same risks of infection. Because of the lack of certainty in this particular respect, British medical investigators are not satisfied that an anti-whooping cough injection has yet been devised which will be as effective as the well-proved immunisation against diphtheria, for instance.

Some authorities in Britain go so far as to suggest that no form of immunisation is likely to be very effective against whooping cough, although others would like to push ahead with immunisation with what has been developed so far. The British Ministry of Health is certainly not sufficiently convinced of the value of immunisation to consider a mass campaign justified. That probably reflects the consensus of medical opinion.

What answer is there to the mother who asks that her child should be immunised against whooping cough? It must be pointed out to her that she cannot be confident that the child will not thereafter get whooping cough. The most she can expect—and this is by no means certain—is that the risk will be diminished and that the attack may be milder. Doses are usually rather large and reactions—sore arms and general disturbance—occasionally occur.

Results of anti-whooping cough injection trials now in progress in Britain will be received with great interest. Their success will depend upon the care with which they are conducted. Latest advice is that the experiments are more encouraging, so that there is still hope that vaccination will be endorsed, but until there is a reliable and proven guide it is not likely that mass immunisation against whooping cough will be adopted in New Zealand. Until then, the safest plan is to maintain baby's resistance against disease generally, and to keep well away from whooping cough contacts.

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A careful long putt of mine rolled steadily up to the hole, then provokingly poised on the extreme edge. I sighed audibly and laughingly exclaimed, "Oh, for an earthquake!" On the instant one really occurred and my ball toppled into the hole. My opponent was so chagrined that she picked up her ball, remarking bitterly, "It is no use trying to play against fate."

—"Twilight," Wanganui.

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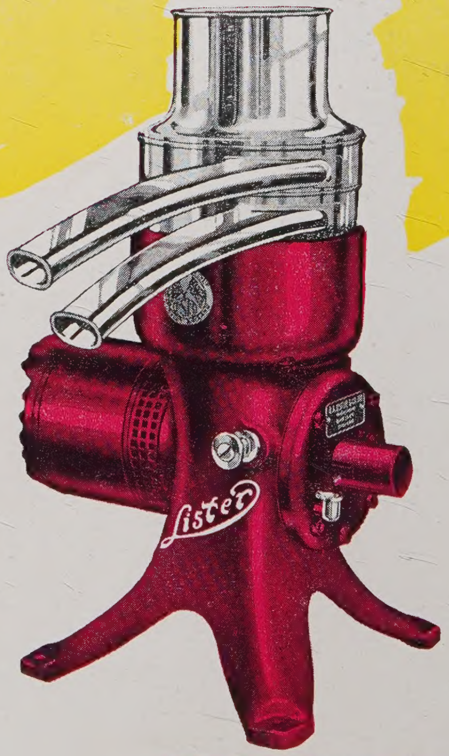

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